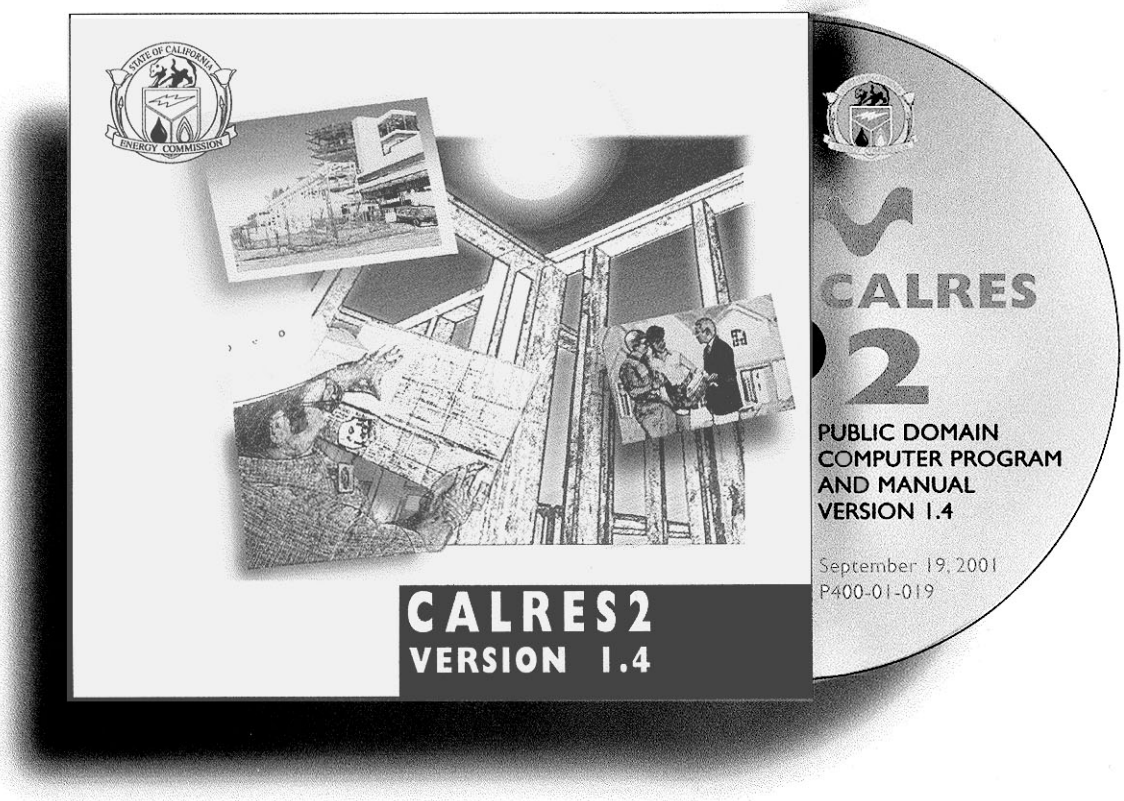
CALRES2

USER'S MANUAL

VERSION 1.4



PUBLIC DOMAIN COMPUTER PROGRAM FOR LOW-RISE RESIDENTIAL BUILDINGS and ADDITIONS

for Compliance with the

2001 ENERGY EFFICIENCY STANDARDS

Effective Date SEPTEMBER 19, 2001

CALIFORNIA ENERGY COMMISSION

COMMISSION ADOPTED STANDARDS

September 2001
P400-01-019

Gray Davis, Governor

Acknowledgements

CALRES2, Version 1.4 is the only public domain computer program available from the Commission for determining compliance with the residential portion of the 2001 Energy Efficiency Standards. The Commission would like to recognize the following staff for their efforts in developing this version of CALRES2:

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Abstract

Public Resources Code (PRC) Section 25402 requires the California Energy Commission (Commission) to prescribe regulations and set building design and construction standards that increase the energy efficiency of new buildings. In addition, PRC Section 25402.1 specifies developing design aids that help developers, contractors, and building officials to understand and thus ensure compliance with the standards. Further, PRC Section 25402.1(a) requires the Commission to develop a public domain computer program that enables contractors, builders, architects, engineers, and government officials to estimate the energy consumed by residential and nonresidential buildings. CALRES2 is such a program for the residential sector, and this document is the CALRES2 users' manual.

CALRES2, Version 1.4, supersedes all previous versions of CALRES and takes effect on the date approved by the full Energy Commission (September 19, 2001). CALRES2 reflects changes made in 2001 to the energy efficiency code for new buildings. Several other software compliance programs are available and are sold by private firms. You may obtain a list of Commission approved private vendor programs by calling the Commission's Hotline at (916) 654-5106 or (800) 722-3300 or by visiting the Commission's website at [www.energy.ca.gov/efficiency].

TABLE OF CONTENTS

1.0 INTRODUCTION AND RESOURCES

1.1 WELCOME TO CALRES2!

CALRES2 is a computer program designed to analyze the thermal performance of a building for determining compliance with the California Energy Efficiency Standards (Standards). It is designed exclusively for residential buildings covered by the 2001 Standards. By definition in the Standards, residential buildings do not include hotels or motels, or apartment buildings with four or more stories.

CALRES2 calculates the energy consumption of a building for space heating, space cooling, and domestic hot water heating. It automatically compares the energy consumption of your building design against the requirements of the Standards. If the building design does not meet the Standards, you can use CALRES2 to evaluate alternative building strategies to reduce energy consumption. When the building design meets the Standards, CALRES2 automatically produces the compliance forms needed for building department review of the building design.

CALRES2 has the following thermal performance modeling capabilities:

- Conduction gains and losses through opaque surfaces
- Solar gains through fenestration including the effects of internal shading devices, external shading devices, fixed overhangs, and fins
- Thermal mass effects to dampen temperature swings
- Space conditioning equipment efficiency
- Water heating equipment efficiency
- Zonally controlled HVAC systems
- Controlled vent crawl space designs
- Sunspaces
- Shading from fins and overhangs
- Exterior mass walls
- Building additions
- Hydronic space and water heating systems

To run CALRES2 you need the following computer equipment:

- An IBM or 100% IBM-compatible personal computer
- At least 640K of random access memory (RAM)
- A hard disk drive
- At least one 1.4Mb floppy disk drive
- A math coprocessor chip

- A monochrome or color video monitor
- DOS (Disk Operating System) Version 2.0 or higher
- A serial or parallel port printer
- A CD ROM or internet connection

1.2 HOW TO USE THIS MANUAL

This manual is divided into five chapters described below. Each chapter explains different aspects of CALRES2, from the basics of getting around in the program to how to use the program for determining if your building meets the requirements of the Standards.

Chapter 1 – Introduction and Resources

Chapter 2 – CALRES2 Installation Procedure

Chapter 3 – Overview of CALRES2 Operation

Chapter 4 – Using CALRES2

Chapter 5 – Advanced Procedures and Special Compliance Topics

Before starting CALRES2, you should have for reference the California Energy Commission's *Residential Manual for Compliance with the 2001 Energy Efficiency Standards (for Low-Rise Residential Buildings)* (*Residential Manual* for short) (publication number P400-01-022) and the *2001 Energy Efficiency Standards for Residential and Nonresidential Buildings* (publication number P400-01-024). The *Residential Manual* explains basic information on using the Standards and what to do in special situations. Instructions for obtaining these and other related documents are found later in this chapter.

1.3 RESOURCES

The Energy Standards

All new buildings in California must meet state standards for energy efficiency. The standards are contained in the California Code of Regulations (Title 24, Part 1: 10-103; Part 6: 100-118,150-152). The California Energy Commission (Commission) prescribes, by regulation, standards that are cost-effective over the economic life of the structure. Periodically, the Commission modifies the Standards to account for changes in the building industry, such as improvements in building technologies or improvements in techniques to analyze building energy performance. In addition, the Commission has ongoing programs to provide manuals, training materials, training programs, public domain energy analysis programs (such as CALRES2), and an Energy Hotline to answer

compliance questions. The Energy Efficiency Standards for residential buildings apply to buildings with Uniform Building Code occupancy type R, as follows:

• Single family dwelling and lodging houses
• Multifamily buildings with no common floors or ceilings, up to three stories
• Multifamily buildings, up to three stories

> **NOTE**: The Energy Efficiency Standards for residential buildings do NOT apply to apartment buildings with more than three stories, hotels, or motels.

Compliance with the Standards

To comply with the standards, you must show that your building meets two basic requirements:

- the building has all mandatory measures installed, and
- the building's predicted annual energy use is less than or equal to the energy budget for that building.

You can show that your building meets the energy budget in one of two ways: a prescriptive package method or a computer compliance method. CALRES2 is a computer compliance method.

Compliance Documentation

Once your building complies with the standards, you must provide documentation to the building department in order to receive a building permit. For a comprehensive list of forms that you must submit, see Chapter 5, Section 5.5, of the *Residential Manual*, and for blank copies of the forms, see Appendix A of the *Residential Manual* or your local building department. CALRES2 can print two of the forms, the Certificate of Compliance (CF-1R) and Computer Method Summary (C-2R), complete with the information you have entered. Other forms must be completed manually. Users should note that two of the completed forms, the Insulation Certificate (Form IC-1) and Installation Certificate (Form CF-6R), must be posted at the job site while the house is under construction. This facilitates building inspectors' verification that the insulation and mechanical equipment installed meet state requirements.

Note that the Certificate of Compliance, the CF-1R, must appear on the building plans and be signed by the applicable parties.

Energy Commission Services and Publications

For more information on the standards, the Commission provides the following:

Energy Hotline

The Commission provides an Energy Hotline for answering questions related to the Standards. The Hotline telephone numbers and hours are as follows:

(800) 772-3300 or (916) 654-5106
Monday through Friday
8 a.m. to noon and 1 p.m. to 4:30 p.m.

Publications

The Commission has publications available that are designed to assist compliance with the standards. Noted below, with their publication order numbers, are those of particular use for residential building design:

- *AB 970 Energy Efficiency Standards for Residential and Nonresidential Buildings* (P400-01-024)
- *Residential Manual for Compliance with the 2001 Energy Efficiency Standards (for Low-Rise Residential Buildings)* (P400-01-022)
- *AB 970 Low-Rise Residential Alternative Calculation Method (ACM) Approval Manual* (P400-01-004)

These publications are available on the Commission's Website, www.energy.ca.gov/title24 (in PDF format), or they may be ordered in hard copy by requesting a publications catalog and order form from the Commission:

Publications Unit
California Energy Commission
P.O. BOX 944295, MS-13
Sacramento, CA 94244-2950
(916) 654-5200

Some of these documents are also available on CD-ROM.

Blueprint and Informational Notices

The Commission publishes a periodic newsletter, the *Blueprint*, which contains answers to compliance questions received through the Energy Hotline. To receive the *Blueprint* regularly, call the Energy Hotline and ask to be placed on Mailing List 50. The *Blueprint* is also available on the Commission's website.

Call the Hotline and ask to be placed on Mailing List 53, to receive ongoing information on Commission residential standards activities, such as development of future standards, meeting announcements, applications for approval of modeling techniques for innovative building products, or workshops.

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2.0 CALRES2 INSTALLATION

This chapter explains how to install CALRES2 using a file sent by electronic mail or CD-ROM.

To run CALRES2, your computer system must meet these specifications:

- IBM or 100% IBM-compatible personal computer
- At least 640K of random access memory (RAM)
- At least one 1.4 Mb floppy disk drive
- Monochrome or color video display monitor
- DOS (Disk Operating System) Version 2.0 or higher
- Serial or parallel port printer
- Hard disk drive
- A CD-ROM or internet connection
- A math coprocessor chip

2.1 INSTALLATION PROCEDURE – File Sent by Electronic Mail

Once you open the email from the Energy Commission, double-click on the attachment called CRSETUP. This is an executable program that will automatically install CALRES2 into a CALRES directory and a shortcut to CALRES2 on your computer's desktop.

While CALRES2 is being installed, a window appears on your computer monitor showing its progress. Once the installation is finished, you can close that window by clicking on the "x" in the upper right corner of that window. To open CALRES2, go to your desktop's directory, find the icon for "Calres," and double-click on that icon. The initial CALRES2 screen you will see is shown in Figure 2-1. If it fills the entire computer monitor screen and you want it smaller, you can shrink the CALRES2 screen by pressing the "Alt" key and "Enter" or "Return" simultaneously. Chapter 4 of this manual takes you through the steps for using CALRES2.

DOS users can also run the CRSETUP program for installing CALRES2, then run CR2 from the CALRES directory.

2.2 INSTALLATION PROCEDURE – CD ROM

Insert the CD into your computer's CD-ROM drive. If your computer does not automatically install CALRES2, click on the Windows "Start" button in the lower left corner of the Windows screen. Go to "Run" and browse until you arrive at the CD-ROM drive and click on the CRSETUP file.

CALRES2 will install into a CALRES directory, with a shortcut on your computer's desktop. Once installation is complete, go to your desktop's directory, find the icon for "Calres," and double-click on that icon to open CALRES2. The initial screen you will see is shown in Figure 2-1. If it fills the entire computer monitor screen, you can shrink the CALRES2 screen by pressing the "Alt" key and "Enter" or "Return" simultaneously. Chapter 4 of this manual takes you through the steps for using CALRES2.

DOS users can run the CRSETUP program too for installing CALRES2. Then run CR2 from the CALRES directory.

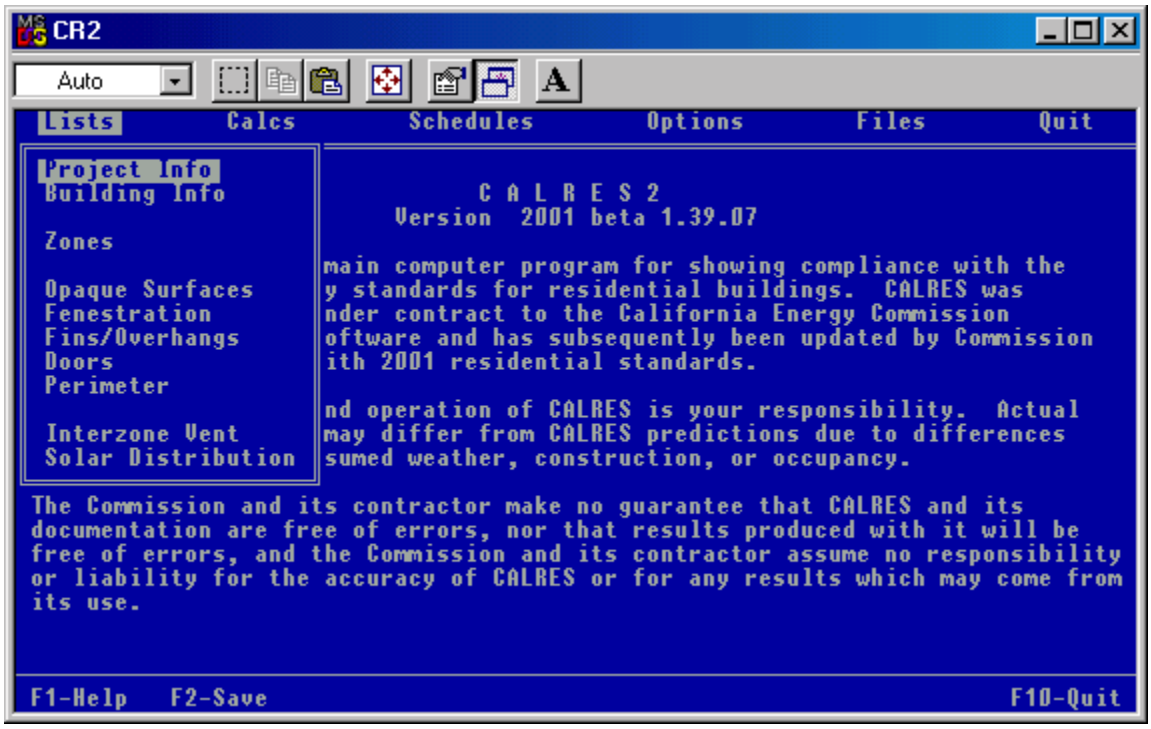

Figure 2-1. Initial CALRES2 Screen

3.0 OVERVIEW OF CALRES2 OPERATION

3.1 FLOWCHART AND SCREENS

This chapter of the manual focuses on getting around in the program. Chapter 4 is a step-by-step description of how to use CALRES2 to analyze a building's thermal performance. Please read the following before proceeding to Chapter 4.

The main screen (Figure 3-1) shows you the categories you will use to enter data about your building, how to operate the program, and how to maintain data files. From each of these categories, you can access a pull-down menu that is specific to that category. Figure 3-1 shows the pull-down menu from the “Lists” category. The right and left arrow keys on your keyboard move your cursor across the options at the top of the screen, and the pull-down menu appears automatically when the cursor is moved to any of the headings.

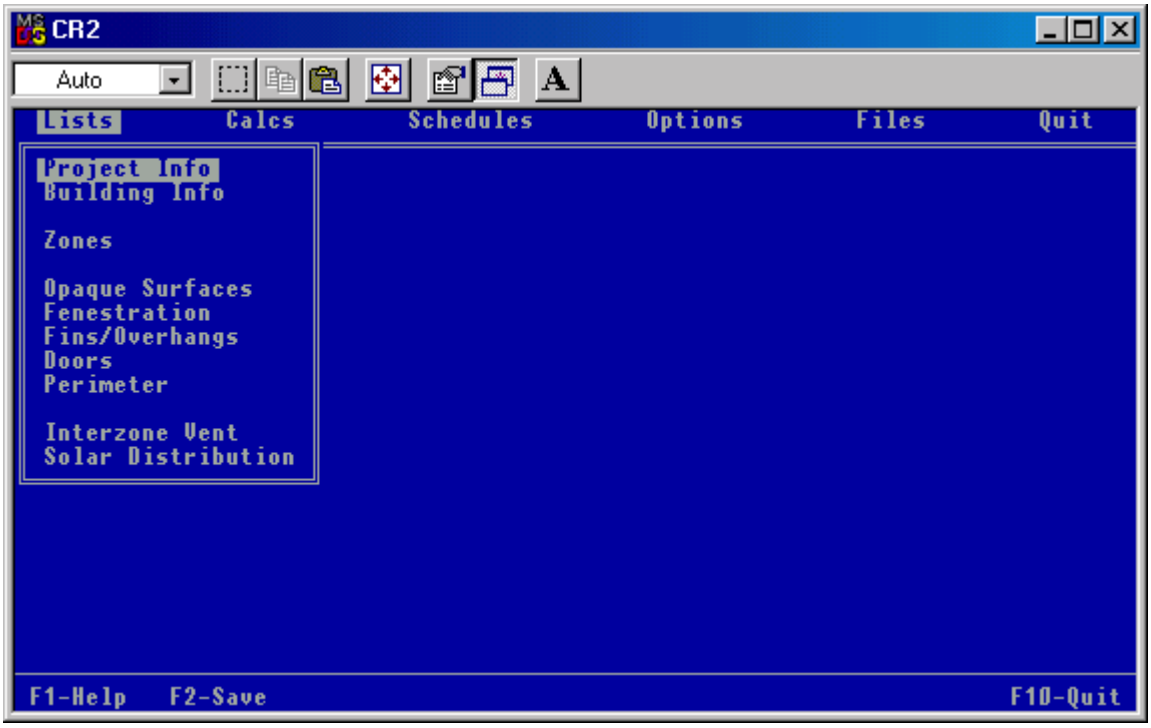

Figure 3-1. Main Screen: Lists Menu

Figure 3-2 is a flowchart that shows the generalized CALRES2 process.

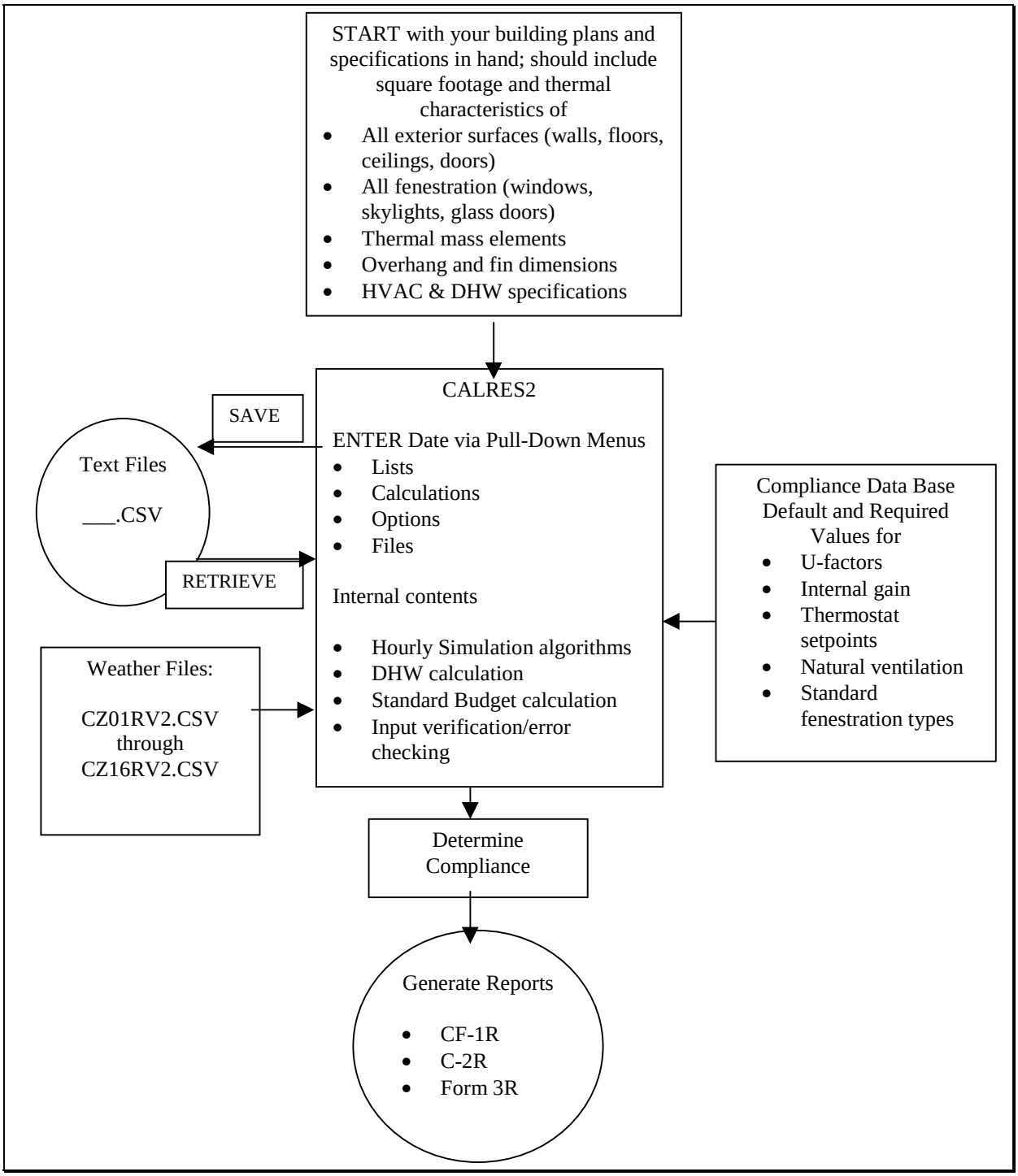

Figure 3-2. CALRES2 Flow Chart

You can access specific sections of the program to input information on your proposed building or perform compliance calculations. CALRES2 allows you to enter building information through either the main screen Lists or Schedules menu. From Lists you select a particular building element from a schedule. The schedule contains a library of one or more default building elements from which you will select the one that describes the proposed design. If a schedule does not contain your particular building element, you can create it using worksheets contained within CALRES2.

When a pull-down menu is displayed, you can move the cursor down the column of choices with the up and down arrow keys and select a category by pressing your keyboard's Enter or Return key. Figure 3-3 shows the information under the Lists menu, Building Info category. To return to the pull-down menu, you press the Escape key once. At any point in the program, the F3 key is also available to return you directly to the main menu screen.

Adding and Editing Building Data

To add or edit building data, CALRES2 recognizes two types of commands:

- A command to enter project data — accomplished by highlighting a selection and pressing the Enter or Return key, or simply typing the data. After you enter data, pressing Enter fastens that piece of data to your project file.
- A command to access schedules — used to access worksheets and a materials library where you can revise the construction assemblies. The "Alt" key is used extensively for this purpose, and a glossary of these commands is at the end of this chapter.

If you choose the wrong command, simply press the Escape key and the screen will move back one step.

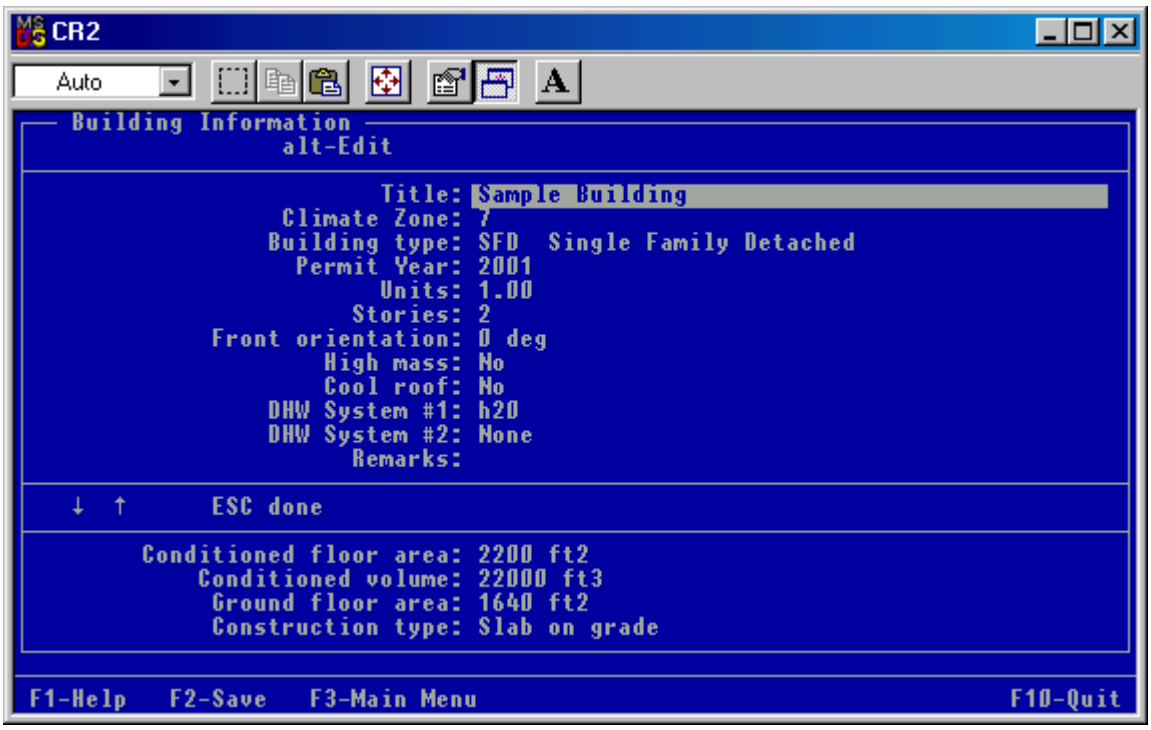

Figure 3-3. Building Info. List

Figure 3-4 shows the Opaque Surfaces screen for a sample house – note four walls, one ceiling type, and several configurations of floor including the main slab, some exposed slab, floor over crawl space, second story floor, and the floor of a patio over unconditioned space (floor-pr). Note also the columns for area (square feet), orientation, tilt, type of construction, and zone.

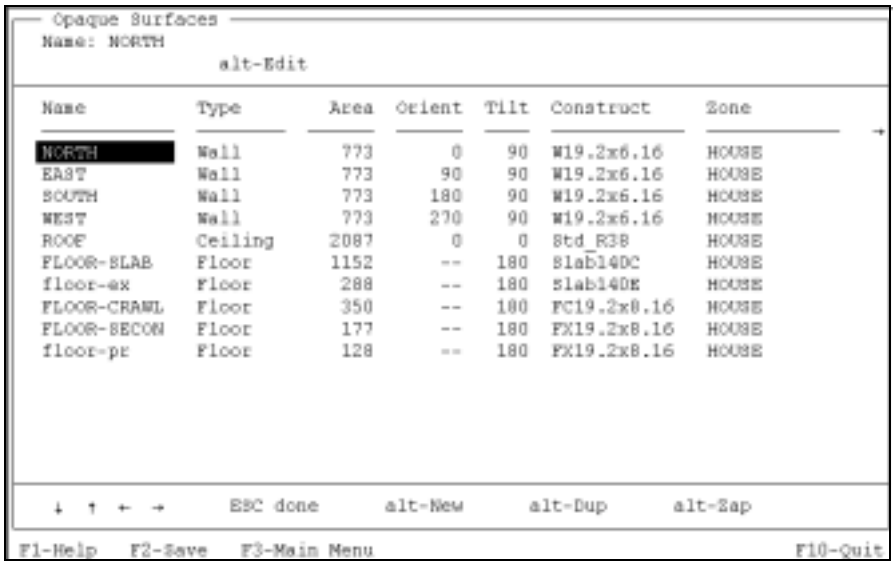

Figure 3-4. Sample Opaque Surfaces Screen

From a screen like the one in Figure 3-4, you can access more levels of CALRES2 screens and worksheets to record more specialized data if you have nonstandard energy features in the proposed house. As you move through each level of CALRES2 screens, CALRES2 will show you where you are (and how you arrived there) by layering the screen headings across the top of your screen. All commands available to you in any screen are listed on the screen either toward the top or near the bottom of the screen. Note in Figure 3-4 that “alt-Edit” appears near the top, and near the bottom are arrow key symbols (indicating that you can use the arrow keys to move around in this screen), ESC done (for Escape), alt-New, alt-Dup, alt-Zap, then F1-Help, F2-Save, F3-Main Menu, and F10-Quit. These and other commands are explained in Section 3.2 of this document.

Protected or Derived Fields

In some parts of the program, you will see the message, "protected or derived field: cannot change here,” such as the Conditioned Floor entry under Building Info. This means either 1) that the program automatically calculates this information from data you provide elsewhere in the program; in Conditioned floor entry case, CALRES2 derives the information from the values you enter through the Lists menu, Zones schedule; or 2) the value is a fixed Energy Commission value.

Weather Files

CALRES2 comes with 16 weather files. These weather files contain the official Commission weather data and cannot be modified by the user. The format of the new weather file name is CZxxRV2.COMMISSION where "xx" is the climate zone

designation. Note that older versions of CALRES weather data will not work with CALRES2.

Help

You can access the Help function in CALRES2 by simply pressing the F1 key at any time. Help will automatically correspond to the subject area you are using in the program. A Help index is also available through the F1 key.

3.2 KEYS USED IN CALRES2

When running CALRES2, you will use the "Alt" key and function keys extensively. The Alt key is used with the first letter of a command. The function keys are used to quickly move around in the program or to save a file. Each screen in CALRES2 shows the commands available from that screen; three dots after a command means that another screen is accessed with that command. Below is a list of commands used in CALRES2.

Alt-	Holding down the Alternate (Alt) key and typing the first letter of any command will execute that command. This includes moving the cursor from one heading to another in the main menu.
Alt-C	Alt-C is used to display input **c**hoices when a choice is available.
Alt-D	Alt-D **d**uplicates a selected record and places the new record immediately beneath the selected record.
Alt-E	Alt-E is used to **e**dit a value in an existing field.
Alt-G	Alt-G (**g**o) is used to start a CALRES2 calculation.
Alt-L	Alt-L repeats the **l**ast value input by the user.

Alt-N	Alt-N creates a **n**ew record.
Alt-M (Calcs screen)	Alt-M is used in the Calcs screen to list data input errors **m**essages to the screen.
Alt-M	Alt-M is used in the schedules to change the program mode from selecting a record to **m**odifying a record.
Alt-P	Alt-P is used to **p**rint Form 3Rs from Construction Schedules and compliance reports from Calcs.
Alt-V	Alt-V is used to **v**iew the results of the last compliance reports from Calcs.
Alt-W	Alt-W accesses **w**orksheets, where applicable, for describing an opaque surface, domestic water heating system, or hydronic heating system characteristics.
Alt-Z	Alt-Z (**z**ap) deletes a selected record.
Ctrl-Break	Ctrl-Break interrupts the program during a simulation or printing.
FUNCTION KEYS (F keys) (Listed below)	Certain function keys are available for quick execution of commands, such as saving a file, exiting the program, or accessing the Help function.
F1 - Help	Press F1 and the Help screen is displayed with information corresponding to your current location within CALRES2.

F2 - Save

Press F2 and CALRES2 will save the current project in a file. A query box will appear asking for the file name.

F3 - Main Menu

Press F3 and CALRES2 will return you directly to the main menu.

F10 - Quit

Press F10 from anywhere in CALRES2 and you will exit from the program. A prompt will appear asking if you would like to save your work before exiting. You can save the file under the current name or under a new name.

4.0
USING CALRES2

This chapter is meant to take the beginning CALRES user through the basics of the program. The instructions in section 4.2 go somewhat beyond the basics and into some depth on several procedures. Do not be concerned about these further instructions your first time through this program.

Chapter 4 Contents

4.1 LET'S BEGIN

Before starting to model your building in CALRES2, have your building plans, blueprints, and/or take-off sheets nearby.

In Chapter 2, you learned how to install CALRES2 and how to open it. Begin now with CALRES2 open. The screen will look like Figure 2-1, reproduced here as Figure 4-1:

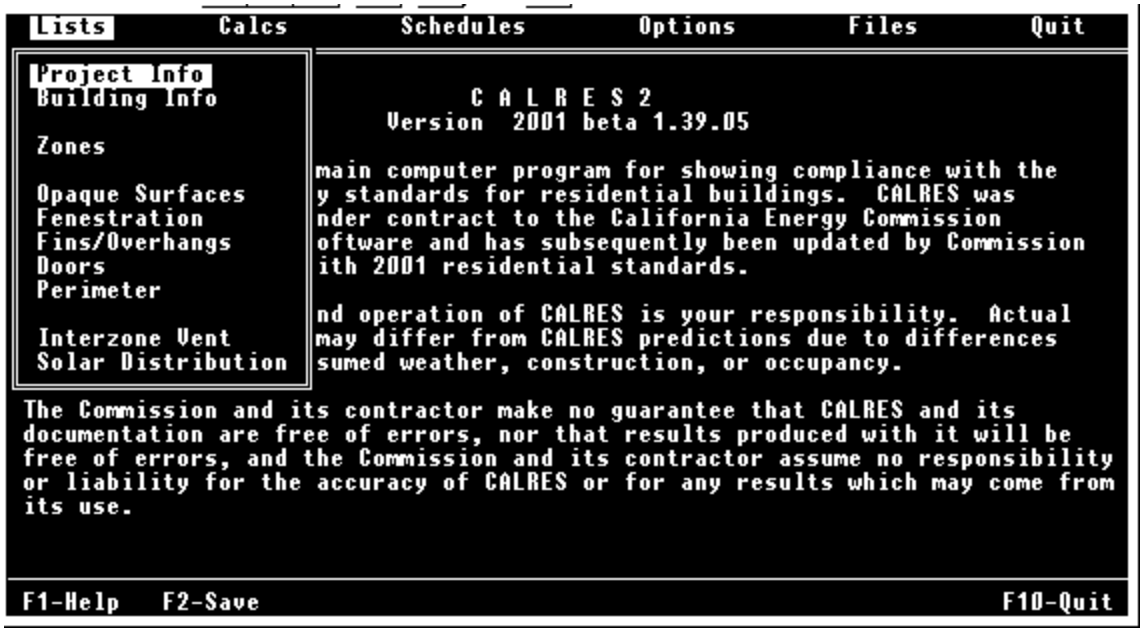

Figure 4-1. CALRES2 Opening Screen

Use the right or left arrow key on your computer keyboard to move through the options across the top of the screen. (**Your mouse is virtually useless in CALRES2**.)

Step 1 - Files.
Use the right or left arrow key to move you to "Files." Note the automatic drop-down menu that says "Retrieve, Save, Clear, View" (see Figure 4-2). The up and down arrow keys move you through these menu options, and pressing "Enter" or "Return" makes your selection. In the future, you will choose from either Retrieve or Save:

- **Retrieve** – for pulling up any files you have created. (Using CALRES2 for the first time, you will use Retrieve to open a sample file that we have included in the program. You must always begin working in CALRES2 by retrieving an existing file.)
- **Save** – for saving your inputs as a CALRES2 file. You can choose a name up to eight characters long with no spaces or punctuation. You can also save at any time by pressing the F2 key.
- **Clear** and **View** are not useful; we recommend ignoring them.

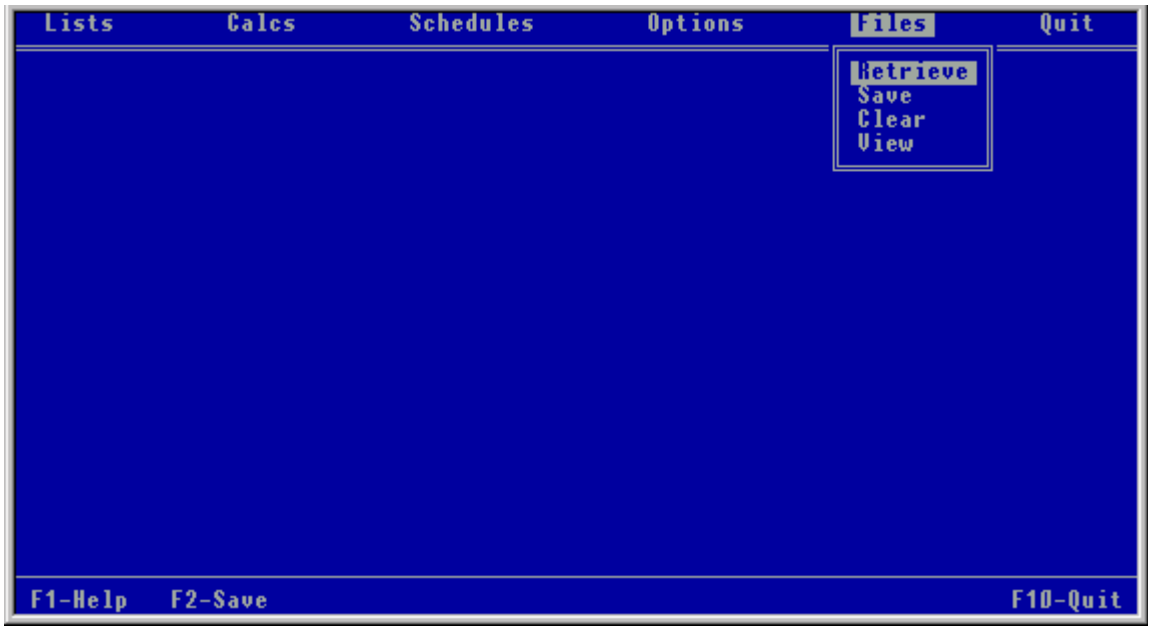

Figure 4-2. Files Options Screen

Step 2 - Retrieve a file.
With the down- or up-arrow key, highlight "Retrieve" and press "Enter" or "Return." As we are starting new, select the sample.csv file: use the down-arrow key to rest the cursor on sample.csv and press "Enter." This loads the sample file into CALRES2 and gives you some basic data from which to start. In the future, whenever you start CALRES2, you must retrieve either this sample file, or another file that you have created, to have a comprehensive basis for modeling a new building.

After loading the sample file, the screen will return to the "Files" drop-down menu you've seen already (Figure 4-2).

Step 3 - Lists.
Use the right or left arrow key to move you to the option called "Lists." Again you'll see an automatic drop-down menu; this one starts with "Project Info" (Figure 4-3). Using the options on this drop-down menu allows you to input information about your proposed house.

Select "Project Info" when it is highlighted by pressing "Enter." You will then see the Project Info screen.

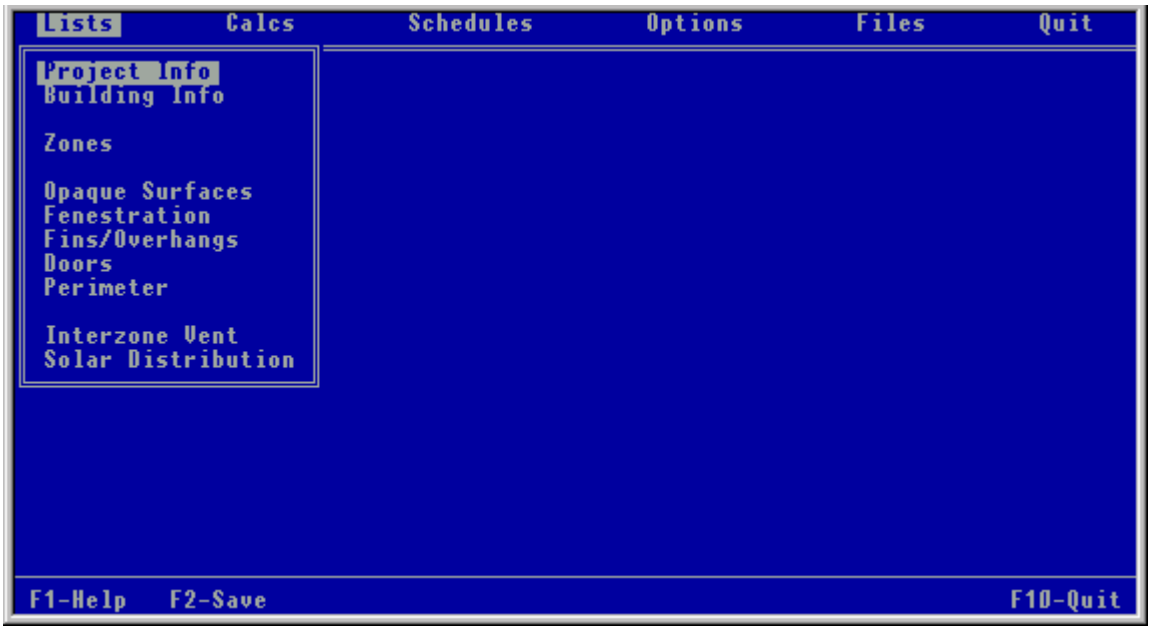

Figure 4-3. Lists Options Screen

Step 4 - Project Info screen (Figure 4-4).
Type in a name for the project such as the homeowners' last name. There may be a brief delay before the typing shows up on the screen. When you finish the name, use the down-arrow key to move down a line – this automatically enters the name you just typed. Type in the next information requested, Project Address, and similarly use the down-arrow key to move to the next lines. Enter all the requested data that you know. You can always return later and add anything you do not know now.

Press the "Escape" key to enter this information; this also returns you to the "Lists" screen.

> **NOTE**: As with any computer program, save your data often. You can save in CALRES2 at any time by pressing the F2 key and, if you wish to keep the same file name, press Enter or Return. (You can change the file name at the prompt before you press Enter).

Step 5 – Building Info.
Use the down-arrow key to move down to "Building Info" and press Enter. You will see the data from the sample file already in place here. You can keep or change any of this information. Let's take this screen one line at a time, because some new commands become available.

Title: Type in a title for this project, up to about 50 letters or characters. Spaces and punctuation are allowed.

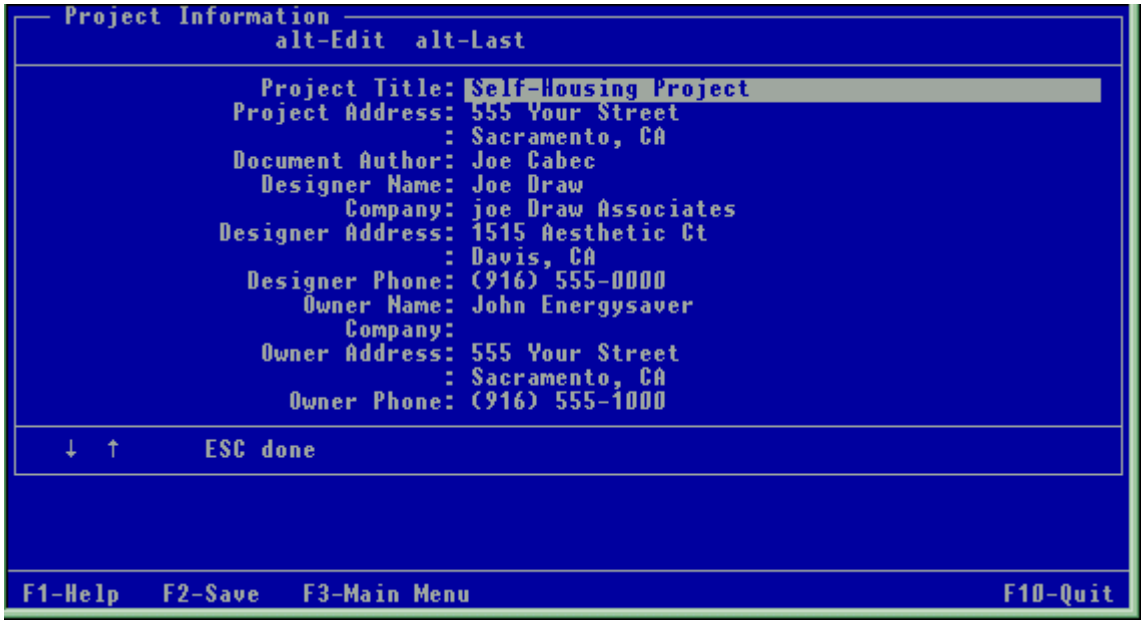

Figure 4-4. Project Info Screen

Climate Zone: California has 16 climate zones, and you must know in which zone the new house or addition will be built. If you do not know and you have obtained the Commission's *Residential Manual* (described in Chapter 1 of this document), you can look up your climate zone in Appendix D. (Note that in Appendix D, the zone number is to the LEFT of the city name.) If you have access to the Internet, you can look up Appendix D of the *Residential Manual* on the Commission's website, http://www.energy.ca.gov/title24/residential_manual/index.html (this site lists all the chapters of the *Residential Manual*; scroll down and click on Appendix D). Your local city or county building permit department will also know the climate zone(s) in its jurisdiction.

When you have determined the climate zone, simply type in the number. As an example, Sacramento, where the Energy Commission is located, is in Climate Zone 12. So we would type in "12." Press the down-arrow key or "Enter" to move to the next line.

Building Type: To view a menu of building type options, press Alt-C (the "Alt" key and the letter "c" at the same time). The menu shows three choices: SFD Single Family Detached, SFA Single Family Attached, and MF Multi-family. The up and down arrow keys move you through these options. Again use the "Enter" or "Return" key to make your selection.

Alternatively, instead of pressing Alt-C to bring up the menu, you can simply type in "sfd," "sfa," or "m" and press Enter.

Permit Year: Type the year (in four digits) in which you expect to apply for the building permit.

Units: If your building is single family, type "1" here. For multi-family, type in the number of dwelling units you are proposing for the building. Press Enter or the down-arrow key. (For detailed information on modeling a multi-family dwelling in CALRES2, see Chapter 5, Section 5.4.)

Stories: Type in the number of stories in your proposed building.

> **NOTE**: We will now stop reminding you to press Enter or the down-arrow key for each entry.

Front Orientation: This is an indication of which direction the front door faces. You will enter a number of degrees between 0 and 360. Due north is considered 0 (and this is true north, not magnetic north), due east is 90, due south is 180, and due west is 270. The angle difference between magnetic and true north varies, so be sure to verify the angle of declination between true north and magnetic north for the building site. (The angle varies between about 12 and 17 degrees in California, with magnetic north lying east of true north in California. True north in California is a larger number of compass degrees than magnetic north.) Your building could be oriented on or anywhere in between the cardinal points.

High Mass: This is a yes/no answer indicating whether or not your building design includes thermal mass for reducing mechanical heating or cooling and you are applying for energy credit for that mass. Details on high mass are in the *ACM Manual*, but briefly the rules are as follows:

- For slab on grade construction, the surface area of the mass must be greater than the equivalent of 30% of the exposed slab area [refer to Chapter 3 (Sections 3-6 and 3-7) and Chapter 4 (Section 4-7) of the *ACM Manual*].
- For nonslab floors, the amount of the mass must be greater than an amount of mass equivalent to 15% of the conditioned nonslab floor area as two-inch thick concrete [refer to Chapter 3 (Sections 3-6 and 3-7) of the *ACM Manual*].

Type "y" or "n" to enter your response.

Cool Roof: This is also a yes/no answer indicating your plan to install (or not) a reflective cool roof as defined by the Commission see www.consumerenergycenter.org/coolroof).
You can receive energy credit for cool roofs in some climate zones because they help reduce the building's summer air conditioning load. (At the time of this writing, the number of cool roof products for sloped residential roofs is somewhat limited.) Type "y" or "n."

DHW System #1: DHW stands for domestic hot water. Indicate your water heater type here. Press Alt-C and choose from standard natural gas, electric, or hydronic. For other situations, follow these instructions:

- For more than one water heater of the same type, you can enter a number greater than 1 under **DHW System #1** by pressing Alt-C, then Alt-M (for Modify). Use the down-arrow key to move to the correct listing if needed, then press Alt-W (for Worksheet). Use the right-arrow key to move to the column called "Number" and type the correct number of water heaters. Press Enter then press Escape three times.

- For two water heaters of different types, use the next line, **DHW System #2**, for the secondary water heater**. Press Alt-C** and choose from the list.

- For detailed information on modeling hydronic systems, see Chapter 5, Section 5.2.

- For multi-family buildings, refer to Chapter 5, Section 5.4.

- For any other kind of water heating, refer to Chapter 5, Section 5.1.

DHW System #2: This line should be filled in only if you have two water heaters and they are of different fuel types. ("None" should appear as a default, or you can type in the word "none" if you have just one water heater planned.) Press Alt-C for the options.

Remarks: Enter any comments you wish to record, up to 122 characters.

You will notice at the bottom of this screen four lines describing square footage, conditioned volume, and construction type. You cannot change these in this screen. If these lines are filled in, they represent the sample data that we included in the program. You will be able to change them in the "Zones" and "Opaque Surface" screens.

Press Escape to move back to "Lists."

Step 6 - Zones.
Select "Zones" and press Enter. The sample entries will appear. The cursor places you on the "**Type**" column, meaning type of zone. Generally, single-family homes are modeled with one conditioned zone. There are several other options: modeling two conditioned zones, "Living" and "Sleeping," which offers energy credit for separate zonal controls designed to save energy; and modeling certain unconditioned zones that also serve to save energy [controlled ventilation crawlspaces (CVCs) and sunspaces]. You will find more information on separate zonal controls in the *Residential Manual*, Chapters 5 and 8; and for details on modeling a two-zone system (Living and Sleeping) in CALRES2, see Chapter 5, Section 5.3.1 of this document. Instructions on modeling CVCs are in Chapter 5, Section 5.3.3, of this document. For information on modeling sunspaces, call the Hotline at (800) 772-3300 or (961) 654-5106.

You must create an entry for each zone type that your house has. Start with the conditioned space. With your cursor in the "**Type**" column, press Alt-C to reveal the options: conditioned space, ventilated crawl space (CVC), or sunspace. Choose "Conditioned" for the conditioned zone and press Enter.

> **NOTE:** Attics and garages are not modeled unless they are conditioned space as defined by the Commission in the energy efficiency Standards. In the case of attics and attached garages, they will be acknowledged when you define the opaque surfaces of the conditioned space and the Exterior Condition of those surfaces.

The next column is **FlrArea** (floor area, in square feet). Type in the number of square feet of conditioned space (the example may have a number entered here; just type in your number to replace it). Press the right-arrow key to move you to the next column, **ClgHgt**.

For **ClgHgt** (ceiling height, in feet and inches), type in the average ceiling height of your conditioned space (the example may show 10 feet, which you can replace just by typing in your number). You can enter feet and inches by typing the number of feet, then a space, then the number of inches. If your ceiling height is eight feet exactly, just type "8" and press the right-arrow key. For eight feet six inches, type "8 6" (8 followed by a space then a 6 then the right-arrow key).

For **Sim ZoneCond** (zone conditions for this simulation), press Alt-C to bring up the choices here (Figure 4-5). For a one-story house, still assuming a single conditioned zone, choose the first option, COMMISSION_Standard (for a two-story house, choose TWO–STORY).

> **NOTE**: CALRES2 has setback thermostats as a default, since they are a mandatory feature. There are several situations for which setback thermostats may be exempted, including noncentral heating or cooling systems and some room additions. See Instruction 1 in section 4.2 for details on changing the default setting at this point in CALRES2.

Press Enter then scroll to the next column in the Zones schedule, **HVAC System**.

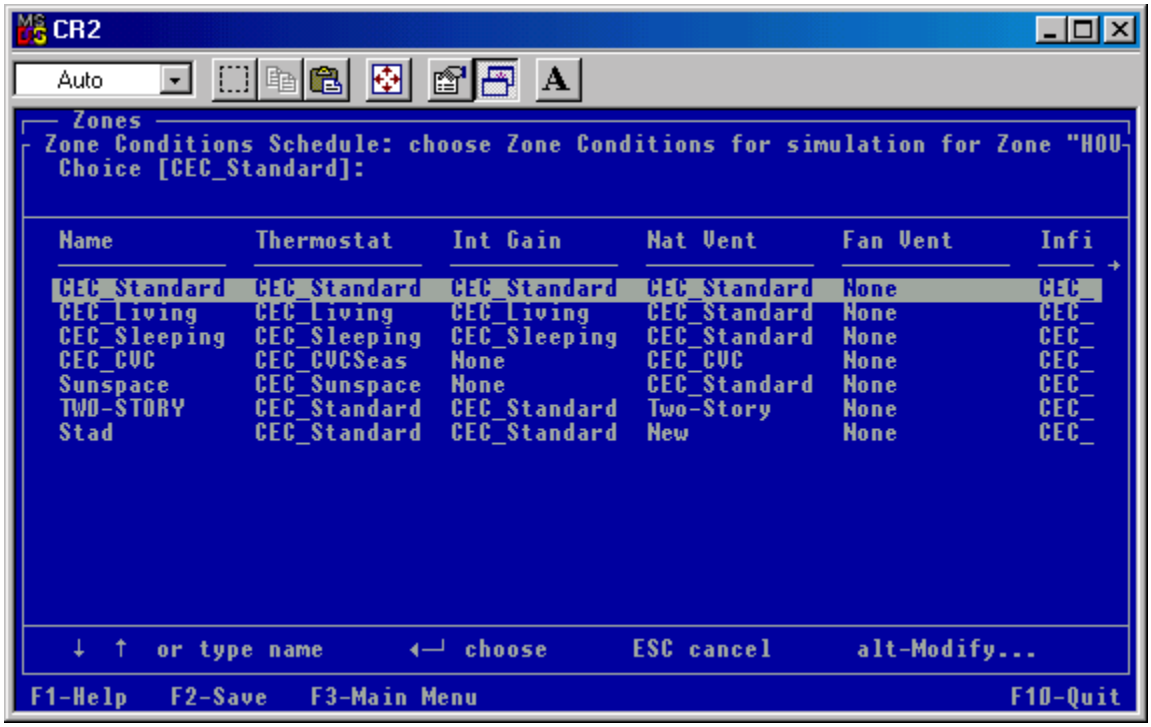

Figure 4-5. Zone Conditions Schedule (Sim ZoneCond schedule)

> **NOTE:** Unless otherwise noted, we recommend duplicating and modifying existing records rather than pressing Alt-N to create New records from scratch. One of CALRES2's peculiarities is that with all its modifications over the years, creating a new record from scratch is likely to omit crucial information.
>
> **NOTE:** The commands available to you at any point in CALRES2 appear somewhere on each screen. For example, when your cursor is in the "type" column in the Zones screen, you can see "Alt-Choose…" (same as Alt-C) near the top of the screen, and some arrow keys, "ESC done," "alt-New," "alt-Dup," and "alt-Zap" toward the bottom. [Pressing Alt-N activates the "new" command, Alt-D the "duplicate" command, and Alt-Z the "zap" (or "delete individual record") command.] The very last line shows F-keys commands available to you. The F-keys are usually at the very top of your keyboard.

Remember to save often! The 'save' shortcut is the F2 key.

For **HVAC System** (Heating, Ventilation, and Air Conditioning), press Alt-C for the choices. These represent standard levels of efficiency in heating and cooling systems. 78/10 refers to a 78% efficient heating system and an air conditioning system rated SEER 10; R4.2 refers to R-4.2 duct insulation for forced air system ducts; and HP6.8 refers to

the efficiency rating of a heat pump system, in this case an Heating Seasonal Performance Factor of 6.8. If your system is not listed, consult Instruction 2 for creating other options in either heating or cooling. If your system is listed, scroll down to the correct one, press Enter, and continue.

If you are **not planning to install an air conditioning system at all**, you must indicate no air conditioning in CALRES2. From the main screen, under the Lists menu, scroll down to Zones and press Enter. Scroll over to the HVAC System column and press Alt-C. An entire line should be highlighted here in the HVAC System Schedule. If necessary, move the cursor so that it highlights a line representing the space heating system you are planning to install (if your heating system is not represented in this list of standard systems, you must create a new system in CALRES2; see Instruction 2. Then press Alt-M to modify that line. Scroll over to the CoolEquip column and type in "None." Press Enter, then Escape, then Enter.

If you are **planning to heat your space exclusively by burning wood or pellets**, you must model that in CALRES2 by selecting the default "Min-.78-10" option. Note that this heating default also includes a default for the cooling system. If this cooling system default does not match your planned cooling system, change the cooling default. From the main screen, Lists menu, scroll down to Zones, press Enter, and scroll over to the HVAC System column. Press Alt-C. Make sure the Min-.78-10 line is highlighted. Press Alt-M and scroll the CoolEquip column. Press Alt-C and select from the cooling system options and press Enter. Press Escape and Enter again to return you to the Zones screen.

> **NOTE**: To use wood heating, you must meet all of the criteria defined in the *Residential Manual*, Chapter 8.

The next two columns **HtEff** and **ClEff** refer to heating and cooling efficiencies and appear automatically; no input from you is needed. The final column is for entering any **Comments** you wish to record.

Repeat these steps if you have a ventilated crawl space and/or sunspace. For more details on CALRES2 modeling of ventilated crawl spaces, refer to Chapter 5, Section 5.3.3, of this document. For sunspaces, contact the Commission's Hotline.

Press the Escape key to return to "Lists."

> **NOTE:** The typical placement of ductwork for distributing heated or cooled air in a home is in the unconditioned attic. You can gain extra energy credit for nonstandard duct design [designed according to the Air Conditioning Contractors of America (ACCA) guidelines], for placing ducts in conditioned space, and for using duct insulation greater than the minimum mandatory R-4.2 level. CALRES2 can calculate these energy credits. To enter relevant information into CALRES2, see Instruction 2.

Step 7 - Opaque Surfaces.
In the Lists menu, scroll down to the next choice, Opaque Surfaces, and press Enter. You will see the columns Name, Type, Orient, Area, Tilt, Construct, Zone, Ext Cond, Adj Zone, and Comment, and some sample data already entered into each column. Here you will describe your walls, ceilings, and floors.

Typically, we describe walls first and we **name** a wall with the compass direction that its exterior faces. You can use the names in the CALRES2 sample file if they fit your situation, or you may change these sample names to reflect the correct compass direction. You may also name walls based on their relationship to the front wall, using “left,” “back,” and “right” as base names (see “Orientation” below). Remember to watch for the commands you can use in each screen; they appear near the top and bottom of the screen.

For Type, press Alt-C and make your selections from walls, floors, ceilings, or interior (thermal) mass. (This might result in a fairly long list, since you will have at least four walls to describe and at least one floor and one ceiling/roof construction.)

> **NOTE**: CALRES2 will not let you choose IntMass1 or IntMass2 unless you indicated Yes for high-mass construction under Building Info. If you did indicate Yes, you are most likely planning for wall or floor mass or both. If both, make use of both IntMass 1 and IntMass2.

For Area, enter the area in square feet for each of the selections you made under Type.

Orientation refers to orientation relative to the front of the building.

Orientation of Walls

The correct orientation of the walls is very important since the walls are used to define the orientation of fenestration.

The Front Orientation of your building that you entered in Building Information sets the orientation of the front door with respect to true north (not magnetic north). For example, a front door facing true south has a 180-degree front orientation under Building Information. In the Opaque Surfaces Schedule, the orientation of the walls is redefined: the "Orient" column means the orientation of each of the non-front surfaces with respect to the front door of the building (assuming you are inside the house looking out the front door). So even though you previously assigned a degree representing orientation for the front door/front wall, at this point CALRES2 needs Front = 0, Right = 90, Back = 180, Left = 270 (still assuming you are inside the house looking out the front door).

EXAMPLE: a house will be built in Sacramento. Using a street map and compass the builder reads 224 degrees for the direction the front of the house will face. Since Sacramento has a magnetic declination of 14 degrees east, the actual front orientation is

238 degrees or approximately west south west. The builder should list 238 degrees on the plans. The energy consultant would enter 238 for the Front Orientation under Building Information. In Opaque Surfaces the consultant would enter 0 degrees orientation for the wall called front. Going clockwise around the building, each wall would be defined in order as Right = 90, Back = 180, and Left = 270 (standing inside the house looking out the front door). Walls that are not at right angles to the primary orientation are also assigned degrees relative to the front wall (see Figure 4-6).

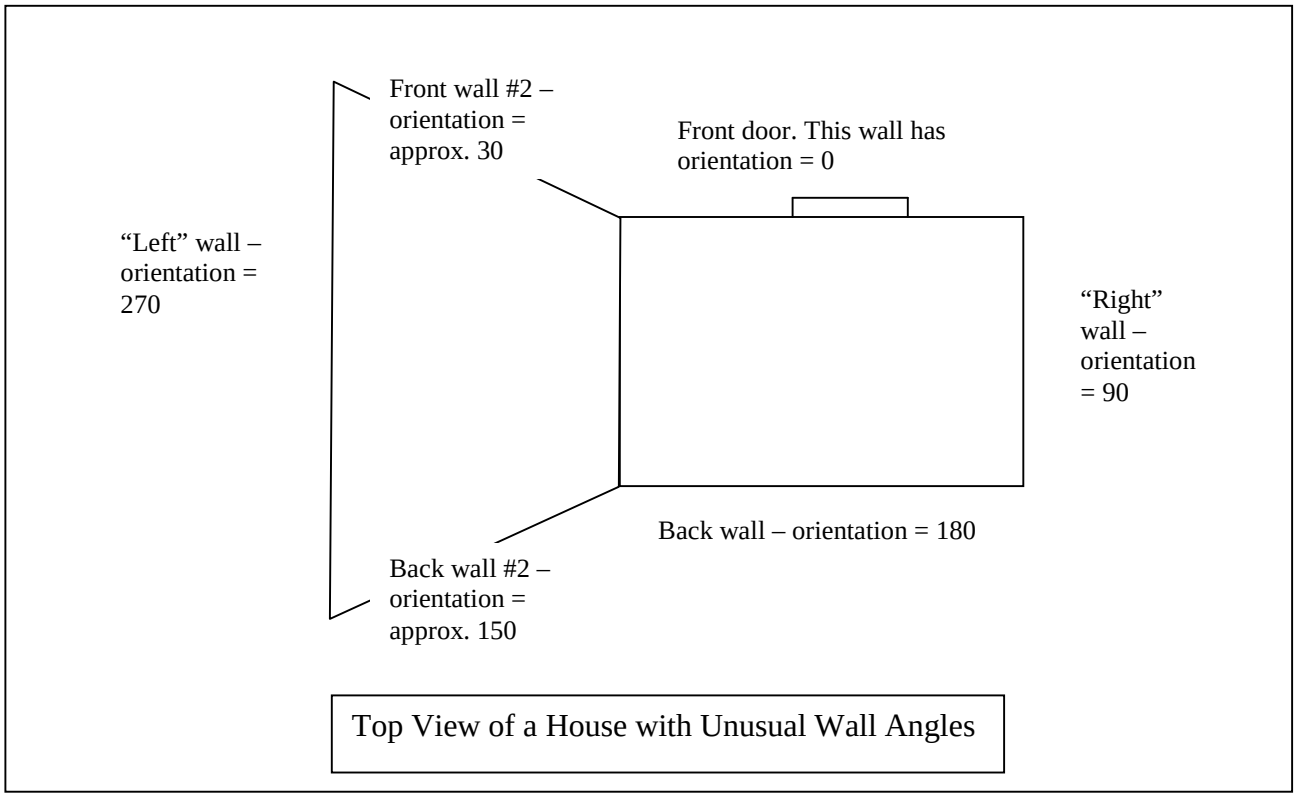

Figure 4-6. Assignment of Degrees to Non-Perpendicular Walls

Tilt fills in automatically. By way of explanation, the tilt of walls is assigned 90 degrees. The tilt of roofs and floors is a little trickier: while a flat roof has a 0 degree tilt, a floor is considered a 180 degree tilt, because of its relation to the conditioned space. You can edit these defaults using Alt-E if you have some unusual configurations.

Because of peculiarities in CALRES2, we recommend modeling any roof slope as 0. It will affect your energy budget only slightly if at all. If you wish to be more accurate, call the Hotline for further instructions [(800) 772-3300 or (916) 654-5106].

For the Construction column, press Alt-C for a long list of choices. A precaution: you may be able to scroll up as well as down from where CALRES2 places you on this list.

The items on the list will vary according to whether you chose wall, ceiling, floor, or interior mass under Type. Here is a brief explanation of those lists:

For Wall: when you press Alt-C under the Construct column, the four options at the very top of the list – R11, 2x4Stud, R19, and 2x6Stud – serve to allow you to add wall assemblies not included anywhere else in CALRES2. (See below for how to do this.) The rest of the list represents standard construction assemblies that are further defined in the *Residential Manual*, but for your convenience here is a sampling of the construction assembly "shorthand" on this list:

- W0.2x4.16 refers to a wall with wood 2" x 4" studs, R-0 insulation, and the studs 16" on center.
- Ws21.2x6.24 means a wall with steel 2" x 6" studs, R-21 insulation, and the studs 24" on center.
- WP14.2x4.48 is a wall panel system with R-14 insulation, 2" x 4" wood framing, and panels 48 inches wide.
  - ✓ WPs14.2x4.48 is the same but with steel studs.
    - ➢ NOTE: Structural integrated panels systems (SIPS) are not on this list of defaults, but as well as other opaque surface assemblies can be created. See the gray box below (Instruction 4) for creating instructions for creating new assemblies.
- W21.EQ4 is a wall with R-21 equivalent and is further defined in the *Residential Manual*, Appendix H.

Select the correct description(s) from this list to describe your walls.

For Ceiling/Roof: A different list of Construction assembly choices comes up for Ceiling (Roof) when you press Alt-C. The first TWO at the very top of the list – R-19 and 2x6Stud – allow you to add assemblies not included anywhere else in CALRES2. (See below for how to do this.) The assembly "shorthand" is the same as for walls, except the first letter is "R" for "Roof" rather than "W" for "Wall."

Typically, vaulted roofs and ceiling areas under attics, given the same insulation level, do not have the same U-factor and may need to be treated differently. You may need to create separate construction assembly records for each type of ceiling or roof construction.

For **Floor**: yet another list appears under Construction assemblies for floors. Note that most of them start appropriately with "F." Here is a brief explanation of the items on this list:

- Slab140E means the concrete has a heat capacity of 140, and the slab is exposed not covered.
- Slab140C means carpeted slab, also with heat capacity 140.
- FC means a wood-frame raised floor with crawl space underneath.
- ✓ FCs – Same but with steel joists not wood.

- FX raised floor with no crawl space under it, such as over a garage, with wood joists.
- ✓ FXs – Same but with steel joists.
- COMMISSION_CVCSoil - select this as the floor of a CVC if your house design includes one.

For Intmass1 and Intmass2: If you are planning high thermal mass, press Alt-C in the Construct column for these rows. Tile may be the only option that pops up. If tile is not what you're planning, press Alt-M and then Alt-W to enter your mass material(s).

• **Intmass1**: Use for interior mass with one side exposed to room air. The mass is not connected to another zone or the outside conditions. Examples are counter tile or tile flooring over a raised floor.

• **Intmass2**: Use for interior mass with two sides exposed to room air, where the mass is not connected to another zone or the outside conditions. Examples are a free standing fireplace, or an interior block wall that does not define a thermal zone boundary.

The next column is **Zone**. With your cursor in this column, press Alt-C and choose one of the options. You must repeat this step for each opaque surface that you have defined; that is, you must assign each surface to the zone type it encloses.

The next column, **Ext Cond,** is the exterior or outside condition of a surface. Press Alt-C for the **Ext Cond** screen (Figure 4-7). The list of choices is quite long, and here is some guidance on how to select:

- Select **Outside** if a wall, floor, or ceiling is exposed to exterior conditions.
- Select **Crawlspace** for any raised floor area that is above a crawlspace.
- Select **Attic** for any ceiling that has an attic above it, with this exception:
  - Select **Attic w/Radiant Barrier** for the appropriate ceiling(s) if you are planning to install a radiant barrier in the attic.
- Select **Unconditioned** if you will have a garage or other unconditioned space on the other side of a surface.
- Select **Grade** for a slab on grade floor, a retaining wall next to a hillside, or any surface below grade. Grade does not assume heat losses to the ground.
- Select **Adjacent Zone** for a controlled ventilation crawlspace, living or sleeping zone, or sunspace.
- For a conditioned basement, select **Shallow, Medium or Deep** ground. These are defined in the Energy Commission's *Rise Residential Alternative Calculation Method (ACM) Approval Manual,* Section 3.2.7. Call the Commission's Energy Hotline for assistance in modeling conditioned basements.

The next column is called **Adj Zone** and is used only where an entry of "Adjacent Zone" appears in the previous column. (The **Adj Zone** is otherwise left blank.) If you have a CVC, sunspace, or two-zone house, you will not leave **Adj Zone** blank.

A CVC, sunspace, and two-zone house all have at least one opaque surface shared by two zones. (The CVC has its ceiling as the floor of conditioned space; the sunspace usually shares a wall with conditioned space; and the two-zone house will have walls and/or floors between the conditioned living and sleeping spaces. You need to indicate in CALRES2 which opaque surface(s) those are, and the Adj Zone column is the place to show this. Chapter 5, Section 5.3.1 and 5.3.3 explain how to do this for two-zone houses and CVCs respectively. (For sunspaces, call the Hotline.) By way of brief explanation, you do not list the same wall or floor twice, as a building component of one zone and a building component of the adjacent zone. Instead, you might say “sunspace” in the Adj Zone column on the line item for the shared wall.

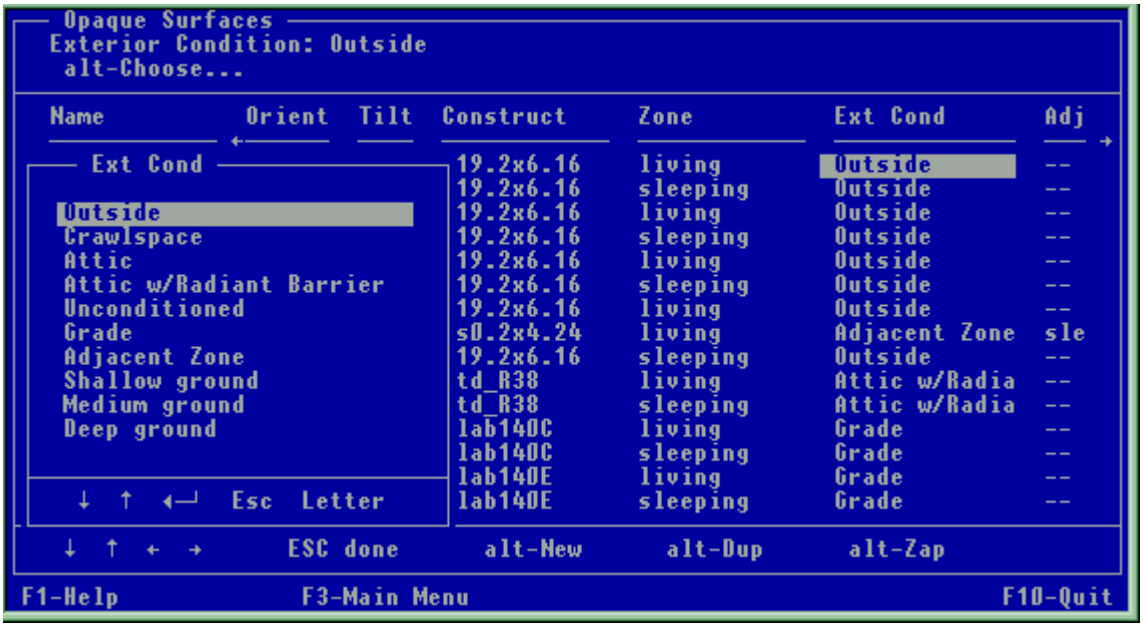

Figure 4-7. Ext Cond (Exterior Conditions) Screen

The final column under **Opaque Surfaces** is for any **comment**s you wish to record. When you are ready to move on, press Escape to return to “Lists.”

Repeat these steps for every opaque surface in your proposed house design: walls, floor(s), and ceiling(s)/roof(s).

Step 8 - Fenestration.
Scroll down to Fenestration and press Enter. In the Fenestration screen, you will see the columns **Name, Surface, Frame Type, Area, Glazing Type, Left D, Head Ht,** and **Comment**.

> **NOTE:** For modeling purposes, you may “batch” windows located in the same wall, with the same orientation, if they have exactly the same U-factor and SHGC. This means that instead of listing each window on a separate line in CALRES2,

each with its own dimensions and other features, you may add together the square footage of those alike windows and pretend they become one big window on that particular orientation. Call the Hotline if you have any questions about this "shortcut."

Name – we recommend that you name each window, glass door, or skylight with a title that identifies its location in the house. For example, you might use "LR West" for a living room west window, "MaBR SLD" for the master bedroom sliding glass door, or "K SK" for kitchen skylight. You must create an entry for every piece of fenestration in the house. Either you can create all the names first then fill in the rest of the columns, or you can name a window and fill in each column for that window before proceeding to the next line.

Surface – press Alt-C and you will see the list of surfaces you generated in Opaque Surfaces. Select the appropriate surface where each piece of fenestration is located, including roofs where you plan to install a skylight.

Frame Type Note: though this column says "Frame Type," it refers to frame dimensions. Press Alt-C and select from the list of options in this Window Frame Schedule and press Enter. Since the options are provided by CALRES2 in its sample file, some of your window sizes might not appear here. If that's the case, press Alt-M then Alt-D. Follow the instructions in the gray box below (Instruction 5) to create a new fenestration size.

The next column, **Area,** is derived from data entered elsewhere, so skip this column.

Glazing Type - press Alt-C for a list of choices that appear in the Glazing Type Schedule. Several of the samples here are standard glazing types, denoted by the beginning letters "COMMISSION"; choosing one of these automatically fills in all the other columns. The choices are as follows:

Glazing Type Choices (abbreviations)	What They Mean
Single	Single pane, clear glass, bugscreen
Double	Double pane, clear glass, bugscreen
COMMISSION_DblStD	Double-glazed, clear glass, regular screen (bugscreen)
COMMISSION_ DblStDSS	Double-glazed, clear glass, woven screen
COMMISSION_SglStD	Single-glazed, clear glass, regular screen (bugscreen)
COMMISSION_ SglStDSS	Single-glazed, clear glass, woven screen
Metal Std	Metal frame, clear glass, bugscreen
MetalLoweSS	Metal frame, low-emissivity spectrally selective glass, bugscreen

MtlTBLoweSS	Metal frame with thermal break, low-emissivity spectrally selective glass, bugscreen
Wd/vynlstnd	Wood or vinyl frame, clear glass, bugscreen
Wd/vynlloweSS	Wood or vinyl frame, low-emissivity spectrally selective glass, bugscreen
GardenWnd	Garden Window
Skylight	Skylight
Blockgls	Block Glass
FmBlckgls	Framed Block Glass

> **NOTE:** To create new glazing types that are not on the CALRES2 list, follow Instruction 6 in section 4.2. If your fenestration matches those listed, simply choose the appropriate ones and skip Instruction 6.

You can skip the next two columns, **Left D** and **Head Ht**, unless you are modeling fins and/or overhangs. Enter any comment you wish to record in the Comment column and press Enter.

(If you are modeling fins or overhangs, see Step 9 below and Instruction 8 in section 4.2.)

Repeat these steps for every piece of fenestration in your house design that has conditioned space on one side and the outdoors or unconditioned space on the other.

Hit Escape to return to "Lists."

Step 9. Fins/Overhangs.
Scroll down to Fins/Overhangs. Before you press Enter, you must determine whether you have fins or overhangs and whether you want to include them in this model. Both are fixed building elements that deliberately or coincidentally shade windows. They can reduce the building's cooling budget but in some cases can increase the heating budget. For most house designs, fins and overhangs will have little impact on the overall energy budget especially with the availability of spectrally selective glass that blocks much of the sun's heat. Even if you have one or the other or both, **we do not require you to include them for modeling purposes**.

Overhangs are horizontal projections above windows (typically the roof eaves that extend beyond the roof edge to shade windows from above). Fins are vertical projections that shade windows, such as bay windows or attached garages that are offset from the main house. See Figures 4-8a, 4-8b, and 4-9 for examples of two overhangs (flat roof extension and sloped eave), a fin (bay window), and the associated CALRES2 terminology. See Instruction 7 below for some rules and hints about including these items in CALRES2.

If you determine that you have fins or overhangs and you wish to include them in this modeling, you must also take extra steps to tell CALRES2 where your windows will be placed. See Instruction 8 below.

Press Enter with the cursor still on “Fins/Overhangs” then press Alt-N (for new) to begin entering details. CALRES2 prompts you for a **name**, which again should be something abbreviated and indicative of location on the house.

For both **Type** and **Wall**, press Alt-C and select from the choices.

For **Left D**, notice the prompt at the top of the CALRES2 screen that says, “Distance from wall left end to F/O left end: ? ft-in.” CALRES2 is asking for the distance in feet and inches from the left end of the fin or overhang going left to the end of the wall, looking at the house from the outside. As before, you can type “4 3” (with a space in between) to represent 4 feet 3 inches, or simply “12” for 12 feet even.

For **Height**, you are asked for the “Distance from wall bottom to F/O bottom: ? ft-in.” This means the distance from the bottom of the fin/overhang to the ground.

For **Depth**, CALRES2 asks you for the “Fin/Overhang depth: ? ft-in,” which means the distance out from the wall.

For **Length**, the “Fin/Overhang length: ? ft-in” means, for overhangs, the horizontal length of the overhang along or parallel to the wall. For fins, it is the vertical length, the distance from the bottom to the top of the fin.

Again, CALRES2 offers a **Comment** column if you wish to make a note here. Press Enter after typing in a comment.

Repeat these steps for as many overhangs or fins you wish to model. After you have entered the relevant data, press Escape to return to “Lists.”

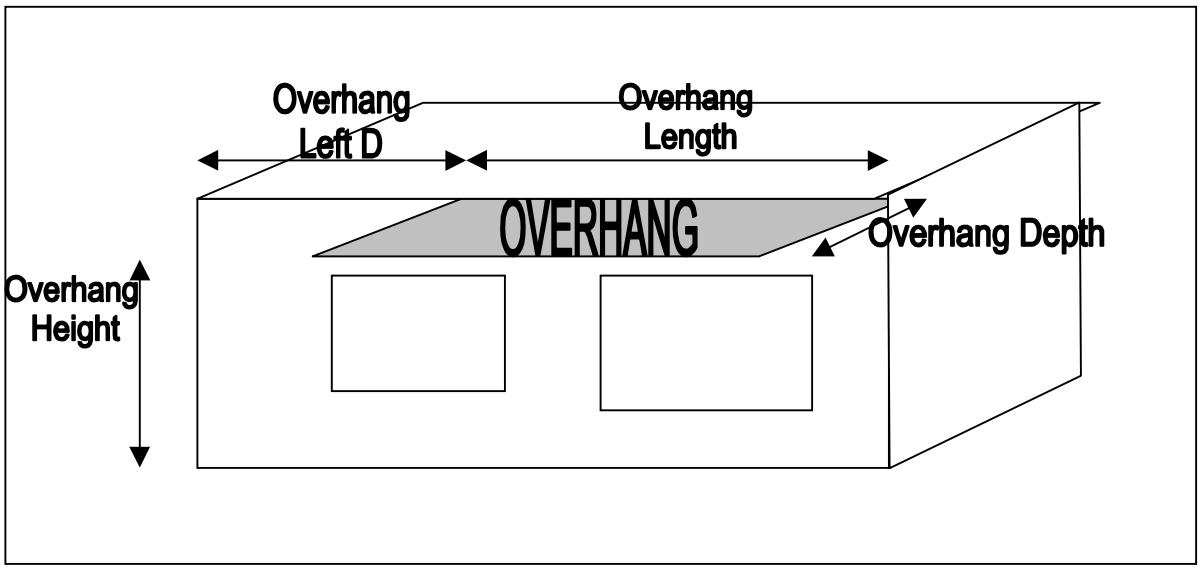

Figure 4-8a. Diagram of Overhang (Extension of Flat Roof) with Terminology

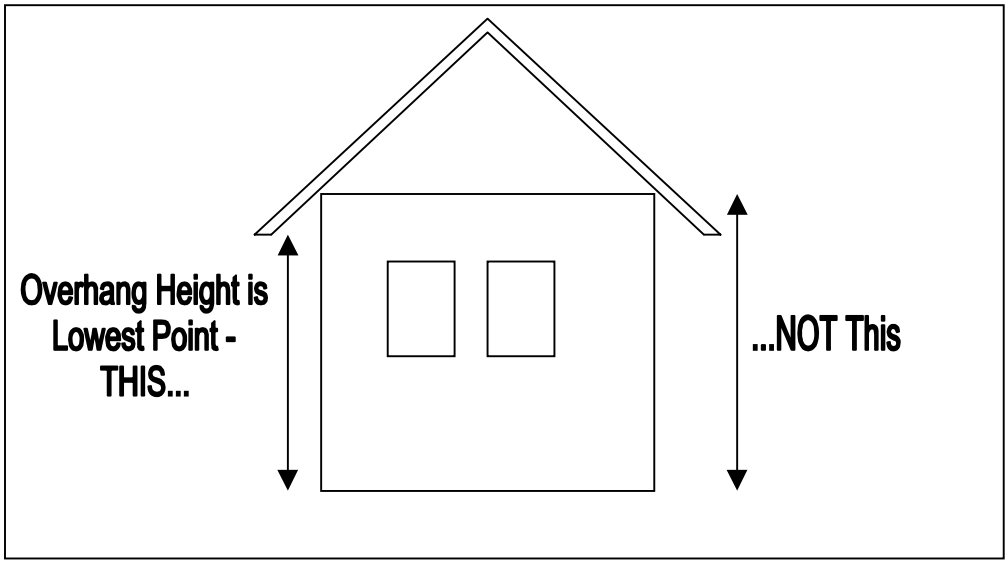

Figure 4-8b. Diagram of Overhang (Sloped Roof Eave) Showing Correct Overhang Height

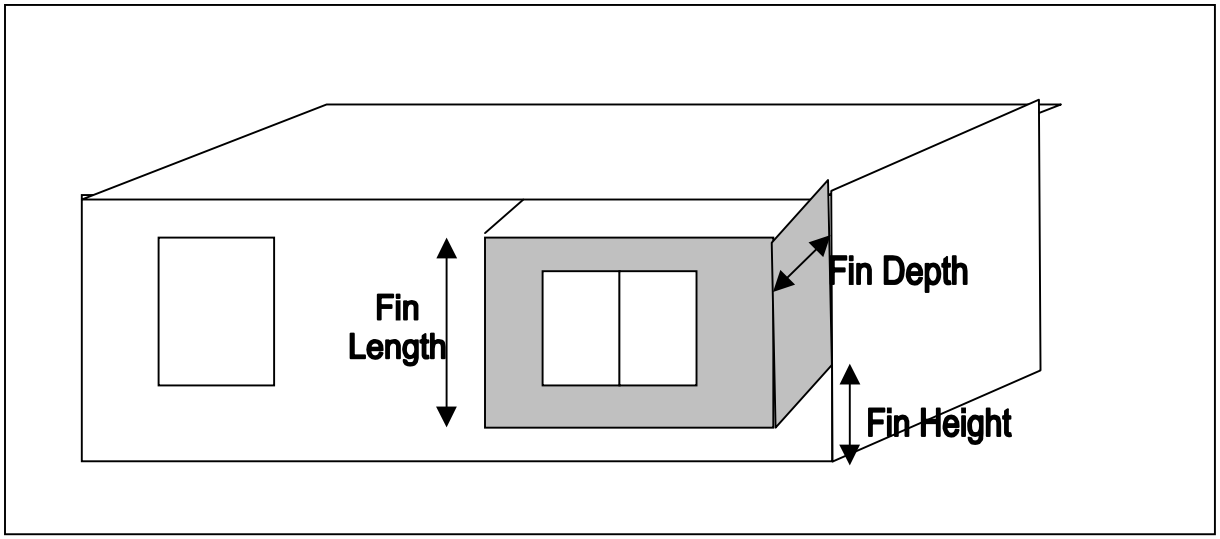

Figure 4-9. Diagram of Fin (Bay Window) with Terminology

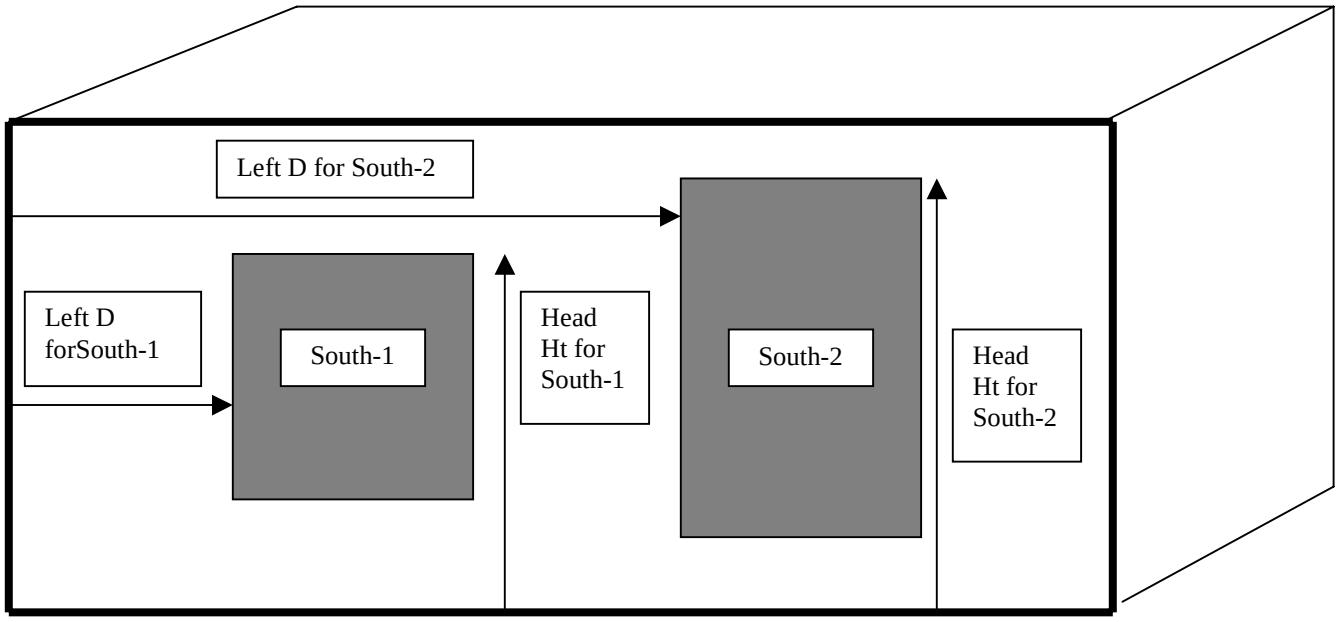

Figure 4-10. Fenestration List Terms

Step 10 - Doors.
Scroll down to **Doors** and press Enter. Any doors included in the sample file will appear. Chances are that all your planned door(s) will not be an exact match to the sample's door(s) in **Surface, Door Type,** and **Area**, so you will have to change the sample's doors or delete them and create new entries for your doors. Since **Area** is calculated automatically from **Door Type**, you have only two columns in which to make changes, so scroll to the appropriate column(s) and press Alt-C.

Under **Surface**, Alt-C brings up the list of opaque surfaces you entered previously. Starting at the front of your proposed house, consider each door in turn (except doors that are all glass, such as sliding glass doors) and fill in all relevant data, as follows:

> Under **Door Type**, Alt-C brings up the door types that are in the sample file: a 30-inch wide wood door 8 feet tall and a double set of 30-inch wide wood doors 8 feet tall. You may use Alt-M to modify one of these existing door types, thereby deleting the original item, or you may use Alt-D to duplicate an existing item on which your cursor rests (this keeps the original item). You need to know the width, height, and U-factor of the door (you may use the default 0.33 for door U-factor). Enter these and any comments.
>
> Repeat for all the doors in your proposed house design.

Press Escape to return to the “Lists” menu.

Step 11 – Perimeter.
Scroll to **Perimeter**, which refers to the length of the perimeter edge of a slab floor. If you have some raised flooring and some slab in your proposed house, include only the slab portion here. You must know the length and width (NOT depth) of the slab floor to calculate the distance around the perimeter of the slab. Enter this distance in the **Length** column.

The next column, **EdgeRval**, refers to whether or not you plan to put insulation around the perimeter edge of the slab. (Perimeter insulation is a good idea in several climate zones; it can help you comply with the energy codes because it results in less heat lost from your house in winter through the concrete into the ground around the slab. R-7 perimeter insulation is **required** in Climate Zone 16.) If you plan to install edge insulation around the slab perimeter, enter the R-value of that insulation in this column. R-7 is the most common. (See Chapter 5, Section 5.2.2, Step 7, for how to treat slab floor perimeters with radiant floor heating.) Scroll to the next column, **Ext Cond** (exterior condition).

Ext Cond refers to what’s on the other side of that perimeter insulation or what the edge of the perimeter is exposed to. Most slab floors are exposed to outdoor conditions. However, when a house has a part slab floor and part raised floor, some of the slab edge could abut unconditioned space. When you press Alt-C in this column, the two choices are Outside and Unconditioned. Choose appropriately for all sections of slab you are modeling.

You cannot change the item in the **F2** (perimeter loss coefficient) column, so scroll to the **Zone** column.

Press Alt-C to show the list of zones you entered and choose which zone the slab floor is under.

Type in any **Comment**s, press Enter, and press Escape to return to the “Lists” screen.

Step 12 - Interzone Vent
This applies only when modeling Living and Sleeping zones (see Chapter 5, Sections 5.3.1 and 5.3.2) or sunspaces (call the Hotline)

Step 13 - Solar Distribution
This applies only for sunspaces or other special solar features such as a trombe wall (call the Hotline for more information)

Step 14 – Review Your Entries.
Before calculating your energy budget and determining if the building you have entered complies with energy standards, we recommend that you review what you have entered in each of the schedules under Lists. From the Lists main menu, scroll down to each of these in succession and review each screen:

Project Info
Building Info
Zones
Opaque Surfaces
Fenestration
Fins/Overhangs
Doors
Perimeter
Interzone Vent

If any entries, especially under opaque surfaces, are remnants of the sample file and do not apply to your building, we recommend that you (carefully) delete them. Call the Hotline if you have any questions about what you should or should not delete.

Step 15 - Calculating Your Energy Budget and Printing Forms
Make sure you're back at the "Lists" main menu. Use the right-arrow key to move to the next column, **Calcs**. Press Enter then Alt-G (for "go"). CALRES2 performs the calculation of your energy budget month by month for the proposed design first, then the standard. It compares the two and lets you know if your building complies with the required budget for your climate zone. If yes, congratulations! If no, you need to adjust the design to make the house more energy-efficient.

Alternatively, you may see that CALRES2 does not complete the calculation and gives you an error message. You must correct the errors in this file before CALRES2 can calculate your energy budget.

How to correct errors
If CALRES2 finds errors in the data input, it will stop the calculation and report the total number of errors in the top left corner of the calculation box. You can review error messages by pressing Alt-M. The Error List shows each error on a separate line. The arrow to the left acts as a pointer and can be moved through the List with the up/down arrow keys. You should examine and correct the input that caused the errors and then try the calculation again. Some common causes of errors include these:

- ✓ The conditioned thermal zone does not have an HVAC system assigned to it under Zones.

- ✓ There is no DHW System referenced in the Building Info List.

- ✓ A wall construction referenced in the Opaque Surfaces List does not have a corresponding record in the Wall Construction Schedule.

- ✓ You have included input values not allowed for compliance.

- ✓ You have incomplete schedule or worksheet information, such as a Schedule referenced from Lists that is not defined in the applicable Schedule.

- ✓ If you try to start a calculation with undefined fields, CALRES2 will report them as errors.

The error messages are structured to direct you to the schedule where the error occurs.

To restart the calculation, you must correct the errors, return to Calcs, and press Alt-G.

If you are unable to identify or correct all errors, we recommend that you call the Energy Commission Hotline at (800) 772-3300 or (916) 654-5106 for further assistance.

Stopping CALRES2 during a Calculation
If you would like to stop CALRES2 while it is calculating the energy budgets, hold down the "Control" key and press the "Break" key.

Viewing and Printing Compliance Reports after Achieving Compliance
You can view the compliance reports following completion of the run by pressing Alt-V (View) if “save reports on disk” is Yes on the Calcs screen. The CF-1R and C-2R reports generated by the last completed run can be printed by pressing Alt-P (Print). Form 3Rs can be printed using Alt-P while viewing the construction schedule worksheet you wish to print.

Printing CALRES2 Reports
Once you have completed all CALRES2 calculations and the building complies, stay in (or return to) the CALRES Calcs screen. Scroll down to the line that reads, “Print Report” and type “yes” then press Enter.

Press Alt-G to run the calculations again.

Printing Problems

Symptom 1: When using Alt-P to print reports, an error message appears that says, “Cannot open file *filename*.xxx [Press SPACEBAR].”

What it means: CALRES2 cannot find the output reports file.

Treatment: Go to the CALRES2 Calcs screen and choose Yes for “Save Reports on disk.” Re-run the simulation.

Symptom 2: "Printing…" message shows up on the screen but nothing happens.
What it means: DOS is sending the printout to a non-existent printer.
Treatment: tell DOS where the printer is. See Tips below.

Symptom 3: "Printing…" message shows up on the screen, followed by a "printer not ready/Press A to abort print, R to retry."
What it means: DOS hasn't gotten a "ready" message from the printer.
Treatment: Make sure the printer is on and is loaded with paper.

Tips for printing

Tip 1: If DOS can't find the printer, chances are neither can CALRES2.
If the printer is connected to anything other than the computer's parallel port, you must configure DOS to send printer output to the alternate port. One CALRES user added commands to the AUTOEXEC.BAT file as follows:

MODE COM2: 96,N,8
MODE LPT1:=COM2:

To test whether DOS can find the printer, type from the DOS prompt:

C:\>copy *filename* prn then press Enter
(*filename* is any text file, such as a ".csv" input file.)
If this doesn't work, CALRES can't print either.

Tip 2: To use Alt-P to print results, reports must be saved on disk.
On the CALRES2 Calcs screen, choose "Yes" for the Save reports on disk choice. CALRES2 will try to pring the file that was generated by the last run. The filename for the reports is derived from the buildings .csv file and from the run number. For example, if the file is HOUSE.csv and the run number was 057, the reports file would be named HOUSE.057. (This won't work if DOS can't find the printer. See Tip 1.)

Tip 3: Output reports can still be printed even if DOS can't find the printer. Save the output reports on disk (see Tip 2), close CALRES2, and open the output reports file with a text editor or word processor. The output reports file is named as in Tip 2. Use the text editor or word processor to print the reports.

Step 16 - Quitting CALRES2
To quit CALRES2 at any time, you can either

1) Press the F10 key, or
2) In the CALRES2 Main Menu screen (Figure 4-11), use the right- or left-arrow key to scroll to "Quit" and press Enter.

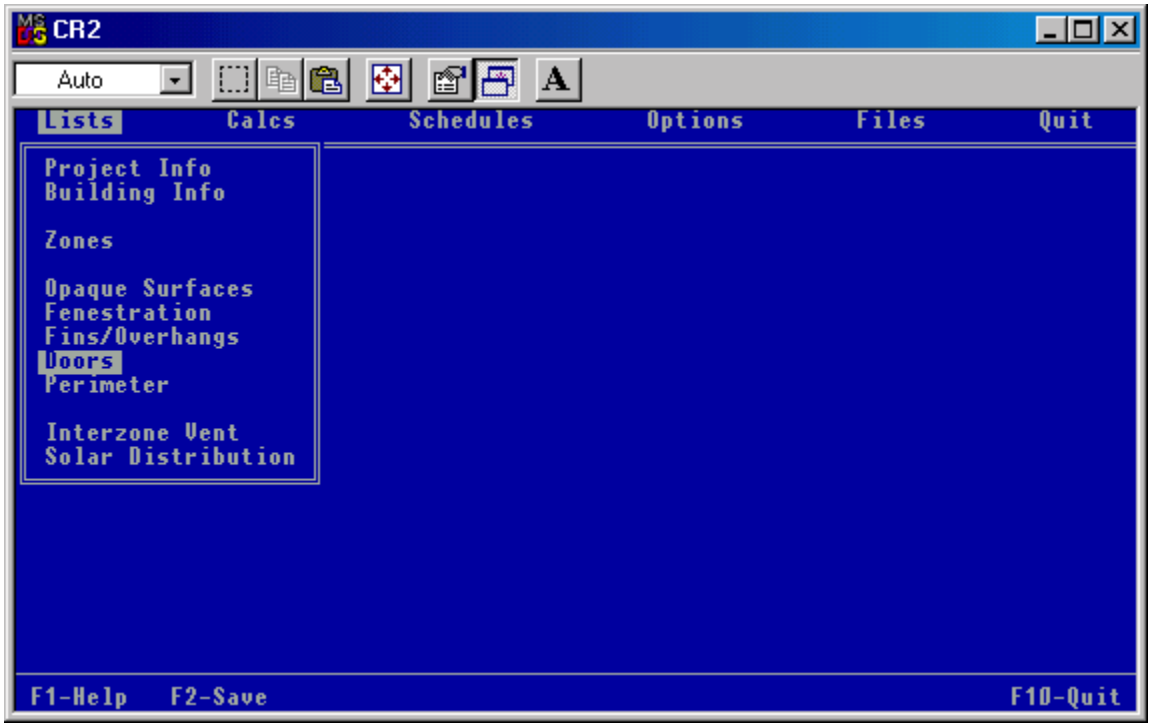

Figure 4-11. CALRES2 Main Menu Screen

From either of these options, CALRES2 will ask if you want to save your current work. If you do, type “y” for yes and press Enter. CALRES2 will prompt you for a name. If you do not type in a new name and if you simply press Enter, CALRES2 will save your work under the file name of the file you have been working in. If you type in a new name, CALRES2 will save your file under that new name when you press Enter. Note that CALRES2 file names are limited to 8 characters.

If you do not wish to save your work, typing “n” for no at the prompt and pressing Enter will immediately quit CALRES2 and not save your last set of entries.

After quitting CALRES2, a blank CALRES screen will still appear on your monitor. Click on the small “x” in the upper right hand corner of the CALRES screen to make it disappear.

MISCELLANEOUS NOTES ABOUT CALRES2

CALRES2 “Crashing”

CALRES2 is a DOS-based program and has somewhat limited memory. Without warning, a prompt may appear asking if you would like to save your data, and once you respond, the program shuts down. If this keeps happening, we recommend that you review the file you're working in for the amount of information you're storing there. Reduce program memory requirements by simplifying the building file. If you have stored a number of constructions or equipment schedules that you are not using in the current building file, use Alt-Z to delete them. Call the Hotline for further assistance.

We also recommend that you save your file frequently while entering the data.

4.2 INSTRUCTIONS

The instructions contained in this section of the chapter go beyond the basic information described in the previous section (4.1). You should be familiar with the program basics before moving to this level of instruction.

Instruction 1. Changing the Setback Thermostat Default to No Setback Thermostat

Mandatory energy efficiency measures include installing setback thermostats for all standard central heating and air conditioning systems. CALRES2 has setback thermostats as a default feature. For noncentral systems in new houses or additions and for some other cases as noted below, no setback thermostat is required. The default in CALRES2 can be changed accordingly.

The no-setback thermostat option can be used for the following situations:

1) For certain non-central space heating or cooling equipment such as gravity wall heaters, wall or room air conditioners, and noncentral heat pumps.

2) For additions for which you are using the Existing plus Addition compliance approach (see Chapter 5, Sections 5.5.2 and 5.5.3) — if the house already has an HVAC system *not* controlled by a setback thermostat and you are extending the existing HVAC system to the addition, you must model the existing system with no setback. Note that you can gain some energy credit if you install a setback thermostat on the existing system and then model the setback thermostat.

3) For additions for which you are using Addition Alone compliance and you are installing conditioning equipment for just the addition —

- If you're installing a noncentral system that cannot be designed to be controlled by a setback thermostat, model No Setback Thermostat.
- If you're installing a noncentral system that can work on a setback thermostat, mandatory measures require you to install a setback thermostat, and it is to your benefit to model it.

- If you're extending existing heating or cooling equipment that doesn't have a setback, model it that way.
- If you're extending the existing system and it *does* have a setback thermostat, model that.

If you have one of these situations and are exempt from the setback thermostat requirement, you must change the default setting in CALRES2, as follows.

How to model no setback thermostat

Step 1
Under Lists move the cursor to Zones and press Enter. Then move the cursor over to SimZoneCond and press Alt-C to open the Zone Conditions Schedule. Press Alt-M then Alt-D to create a new line. At the name prompt, type in NoSetBack and press Enter.

Step 2
Move the cursor over to the Thermostat column and enter Alt-C, which will open the Thermostat Schedule. Move the cursor down until COMMISSION-NoSetBck is highlighted and press Enter.

Step 3
To assign the new assumption, press Escape and then Enter. The NoSetBack that you created should now be listed under SimZoneCond.

Instruction 2. Creating New Space Conditioning Systems

The CALRES2 sample file includes a number of standard space conditioning systems available on the market and their specifications. To allow for new types of or higher efficiency systems available after release of CALRES2, we have provided a means to enter new systems into CALRES2. Creating a new heating or cooling system follows the same basic pattern of commands as with many other procedures.

HEATING SYSTEMS – Gas-fired Furnaces, Heat Pumps, and Electric Resistance (for Hydronic Systems, see Chapter 5, Section 5.2)

Step 1
From the Lists menu, scroll down to Zones, press Enter, then scroll over to HVAC Systems. Press Alt-C to get into the HVAC System Schedule. Place the cursor on the line of an existing system that resembles the type of system you want to create. Enter Alt-M to edit the schedule and then Alt-D to create a new line. Type in the name of the new system and press Enter.

Step 2
Move the Cursor over to HtEqType (Heating Equipment Type) and press Alt-C to bring up the HtEqType Schedule. Place the cursor on the type of system you want and press Enter.

Step 3
Move the cursor to the right under HeatEquip and enter Alt-C to get into the Furnace, HeatPump, DHW/Hydronic or Electric Resistance Schedule (depending on which type of system you selected under HtEqType). Press Alt-M to modify the schedule you are in and then Alt-D to create a new line. Type in the name of the new system. Choose a name that identifies the system efficiency and press Enter.

The steps now split up according to the kind of system you have: gas-fired, heat pump, or electric resistance:

For Gas-Fired Furnaces

Step 4
Move the cursor under Type and enter Alt-C to open bring up a list of furnace types. Place the cursor on the type of furnace you are using and press Enter.

Step 5 (conditional)
If you are using a system with a higher efficiency than the default value listed in the AFUE column, move the cursor to the AFUE column, type in the efficiency of your system, and press Enter.

Note: The value listed in the AFUE column is the default for the standard. For certain non-central furnaces, CALRES2 uses a different AFUE default as the standard.

Step 6 (conditional)
If you are modeling a non-central system, or if you have an unusual distribution system for the conditioned air, you must change the entry for distribution. From the "Furnace Schedule: modify" screen in Step 5, press Escape then press Enter. You should now be in the "HVAC System: modify" screen. Move the cursor to the HeatDist column.

If you have a non-central system such as a wall or floor heater, type in None. Press Enter. If you have an unusual distribution system, or want to take energy credits for ducts systems designed according to Air Conditioning Contractors of America standards, refer to Instruction 3a or 3b in the gray boxes below.

Go to **Step 7** below.

For Heat Pumps

Step 4
Move the cursor under Type and press Alt-C to open the Heat Pump Schedule. Place the cursor on the type of heat pump you plan to install and press Enter.

Step 5
Look across the line where your cursor is resting and note any question marks ("?") in any columns. You will have to fill in those columns with the appropriate data. You may have to scroll off the screen to view all the columns. Some of the columns will be filled in with a default value, and if your equipment has different specifications than these defaults, type in the correct information.

HSPF (Heating Seasonal Performance Factor) and SEER (Seasonal Energy Efficiency Ratio) are efficiency ratings. You can obtain HSPFs by calling the Commission Hotline. The default value is 6.6 for a packaged unit and 6.8 for a split system. If you have a room unit, calculate the HSPF using the formula in the *Residential Manual* (Appendix G, under Converting Efficiencies and Coefficient of Performance). Type in the HSPF and press Enter.

If you have a room unit, you may type in the EER in place of the SEER. Press Enter.

Note the next column called TXV. If you have a split system and are planning to install a thermostatic expansion valve (TXV), an energy-saving device, be sure to change the TXV entry to Yes (type in Yes and press Enter). If not installing a TXV, skip to the next paragraph. (More information on TXV installation and inspection criteria can be found in Chapter 8 of the *Residential Manual,* publication number P400-01-022.)

The next column is ClCap (cooling capacity). If relevant (that is, if there is a "?" in the column), enter the cooling capacity of the unit in kBtu/h and press Enter.

The next four columns (two each for electric systems and two for gas-fired systems) are the heating and cooling COP, orcoefficient of performance. Again, if there is a "?" in these columns, type in the data, and be sure to press Enter after each entry.

Note: If you are planning to install a nonstandard air distribution system, or if you want to gain extra energy credits for designing ducts according to Air Conditioning Contractors of America (ACCA) standards, follow the appropriate Instruction 3a or 3b below.

No Step 6 for heat pumps – Skip to **Step 7**.

For Electric Resistance Heating

Step 4
Move the cursor under Type and enter Alt-C to open the Electric Resistance Schedule. Move the cursor to one of the defined systems (Convective, Radiant, or Central) and press Enter to assign the unit to your system. Press Escape then press Enter.

Step 5
Move the cursor to the Heat Dist column and press Alt-C for the selections on heat distribution. Select one and press Enter. If you wish to record any comment, type it in under the Comment column and press Enter.

No Step 6 for electric resistance heating – Skip to **Step 7**.

Step 7
If you haven't already, press Enter once you have completed all the inputs. If CALRES2 won't accept Enter, press Escape once or twice until an entire line is highlighted in white, then press Enter to assign the new data. You may want to press Escape several times again to return to the Lists menu.

COOLING SYSTEMS – Split Systems, Packaged Systems, Room Air Conditioners, Evaporative Cooling Systems

Step 1
Starting from the Lists menu, scroll down to Zones then scroll over to HVAC Systems. Press Alt-C to get into the HVAC System Schedule. With the cursor on any line, press Alt-M to edit the schedule and then Alt-D to create a new line. Type in the name of the new system and press Enter.

Step 2
Move the cursor over to CoolEquip and press Alt-C to bring up the Air Conditioner Schedule. Press Alt-M then Alt-D, and in the name space provided, type a name that describes the unit and press Enter. You may use the same name you entered in Step 1.

Step 3
Move the cursor to the Type column and press Alt-C to open the Type Schedule. Move the cursor down to the type of system you are planning and press Enter. (Note: you may need to scroll down off-screen to view all the selections.)

Step 4
Look across the line where the cursor is resting for any question marks (?) that may have appeared after you selected Type. These represent items that you need to fill in. In addition, some default numbers may have appeared that you need to compare to those of the equipment you plan to install. If the SEER (see next paragraph) column has a number that does not match the SEER of your intended system, move the cursor over to the SEER column and type in the SEER value for the planned unit. If you are using a non-central air conditioner, use the EER in place of the SEER.

SEER is the Seasonal Energy Efficiency Ratio of a heat pump or air conditioner. CALRES2 uses this value to calculate the space cooling energy consumption of the building. The default values are 9.7 for packaged systems and 10.0 for split systems. EER, or Energy Efficiency Ratio, is the corresponding energy rating for non-central air conditioners. The EER is used in place of the SEER when modeling room or through-the-wall type units.

For gas-fired cooling systems, you will need to fill in the COP, or Coefficient of Performance.

Step 5
Note the column called TXV. If you have a split system and are planning to install a thermostatic expansion valve (TXV), an energy-saving device, be sure to change the TXV to say Yes. (More information on TXV installation and inspection criteria can be found in Chapter 8 of the *Residential Manual*, publication number P400-01-022.)

Step 6
Once you have completed entering the data on the cooling system, press the escape key and then press Enter to assign the unit to the HVAC System Schedule.

Step 7
To assign the new system to the zone press Escape and then press Enter. In the Zone listing, the name you assigned for the new system should appear.

Instruction 3a. Space Conditioning Distribution Systems - Duct Credits or Designs

Conditioned air distribution systems are described in terms of the location (conditioned space, attic, crawl space, basement or special), design, and the R-value of duct insulation. If you choose a "Special" duct location, you must list the heating and cooling fan capacities (only "Special" duct location allows changes to fan capacities – see Instruction 3b below for modeling "Special" ducts). The worksheet has fields for Duct Type (Supply/Return), Duct Location (Conditioned/Attic/Crawlspace/Basement), Duct Length, Surface Area, and Insulation R-value. A description of how to input new duct distribution follows.

The default provided for distribution systems is COMMISSION_100%R4.2 (the 100% refers to all ducts in the attic in a one-story house, or for a multi-story house, 65% in the attic and the rest in conditioned space; and R4.2 means the standard duct insulation level R-4.2). [Note: The default information has the Leak Test set at "No." When run against the standard design, this default system will not comply because the standard was recently changed to include sealed ducts (Leak Test = Yes) in all climate zones].

If you do not want to lay out or design the entire distribution system but still want to gain credit for duct location or tight ducts, follow the instructions below. You can also gain credit for designing the distribution system if you do so according to Air Conditioning Contractors of America (ACCA) guidelines.

Note: Using building cavities instead of ducts as air plenums is no longer allowed.

Step 1
With the cursor under **Lists,** move to **Zones** and press Enter. Then move the cursor over to HVAC System and press Alt-C to enter the **HVAC System Schedule**. Press Alt-M then scroll over to either **HeatDist** or **CoolDist** and enter Alt-C. This will put you into the **Distribution Schedule**.

Step 2
Press Alt-M then Alt-D to duplicate a line. At the prompt, type in a name that represents the system and press Enter. Here you can change the location of ducts (DuctLoc), Leak Test, or ACCA design.

Step 3
If you want to change the duct location, move the cursor to the DuctLoc column. Press Alt-C and select from Conditioned, Attic, Crawlspace, Basement, or Special. You can use "Conditioned" only if your ducts will be installed in conditioned space according to the guidelines in the *Residential Manual*, Chapter 4. "Special" refers to an unusual or custom-designed duct location configuration. Select "Special" if you have a duct design or want to take credit for more than the standard duct insulation, or if you need to model the ducts because they are located in multiple conditions. See Instruction 3b for modeling Special Ducts.

Be sure to press Enter after moving the cursor to your selection.

(Note: the duct installer must certify on the CF-6R form that the ducts are installed in your selected location to aid local enforcement agency's inspections.)

"Leak Test" means that once your ducts are installed (no matter where), you will have them tested for air leakage, and they will comply with the maximum leakage allowed. You must have the air leakage test performed by a Home Energy Rating Systems (HERS) rater. To indicate that you will have an air leakage test on your ducts, move the cursor to the Leak Test column and either type in "Yes" or press Alt-C and select "Yes." Press Enter.

NOTE: If you take credit (Yes option) for the Leak Test or ACCA Design (see next paragraph), these options must be specified on a *HERS Required Verification* list. There are several additional requirements when claiming these and other related credits. Details are provided in Chapter 4 (Section 4.1) of the *Residential Manual*.

If you intend to have your duct system designed according to Air Conditioning Contractors of America (ACCA) standards (see the *Residential Manual*, Chapter 4 or Appendix K) and you want to gain energy credit for this design, move the cursor to the ACCA design column and either type in "Yes" or enter Alt-C and select "Yes." Press Enter.

Step 4
Once you have completed your changes, press Escape. The cursor will highlight the line where you made changes. Press Escape to select these changes and return you to the HVAC System Schedule: Modify screen. Press Enter to record your data and bring you back to the HVAC System Schedule with the new distribution system assigned to heating or cooling (whichever you started in).

Step 5
You must make the appropriate selections for both the heated and cooled air duct system even if they will be the same ducts in your new house. If you just completed the heated air duct system, move the cursor over to the column called CoolDist (you may need to keep scrolling to the right to find this column that is off the main screen). Press Alt-C and select the distribution system you just created. If you have a different distribution system for cooled air, repeat Steps 2 through 4 above. Then continue with Step 6.

Step 6
You should be back in the HVAC System Schedule. Press Escape to assign the new features of the conditioning systems and return you to the Zones menu.

Instruction 3b. Modeling "Special" Duct Situations

If you want to change the duct insulation R-value or model the exact duct distribution system, you must use the "Special" condition as described here. This "Special" condition also allows you to input duct systems as designed rather than having to use the default assumptions for length and surface area. You can select both supply and return ducts and their locations with the same options available on the Distribution Schedule as described above. If you have more than one supply or return, they can be entered separately. You can enter up to six different configurations. If you choose "Special" duct location, you must list the heating and cooling capacities of the system's fan (only "Special" duct location allows changes to fan capacities).

Step 1
From the main screen with the Lists drop-down menu, move the cursor to Zones and press Enter. Scroll to the HVAC System column. Press Alt-C to get into the HVAC Schedule. Press Alt-M and move the cursor over to HeatDist or CoolDist and press Alt-C.

Step 2
You will be in the Distribution Schedule. Press Alt-M, then Alt-D. At the Name prompt, type an appropriate name for your special duct configuration, and then press Enter. Move the cursor to DuctLoc and press Alt-C. Move the cursor to Special and press Enter. Press Alt-W to get to the Distribution worksheet. It should appear blank (unless you are working on a file into which you previously entered data).

Step 3
In this Distribution worksheet, press Alt-N to create the first line. After creating this line, you will be able to press Alt-D (Duplicate) to create additional lines. Depending on your duct configurations, you may need to create a number of new lines; CALRES2 allows up to six. For each set of ducts you are modeling, fill in the following:

Under Type, press Alt-C, select Return or Supply, and press Enter.

Under DuctLoc (Duct Location), press Alt-C, select from Conditioned, Attic, Crawlspace, or Basement, and press Enter.

Under Duct Len, or duct length, type in the number of linear feet of one size and type of duct proposed for your house. As mentioned above, you will have several lines of data for the different diameters of both supply duct and return ducts. Press Enter.

Under Aduct, or area of duct, type in the number of square feet of duct surface area of each type and size of duct. This may require some calculation (for round ducts, surface area = duct length x duct external diameter x π).

Under Rduct, or R-value of the duct insulation, type in your expected R-value. NOTE: ducts in conditioned space do not require insulation, so you cannot make an entry for R-value if you selected Conditioned under DuctLoc.

Under Comment, type in any notes you wish. Press Enter.

You must repeat Step 3 for each individual run of ducts. Groups of ducts that have the same location and diameter can be batched together. For example, two runs of 10-inch return duct in crawl space can be grouped and included as one CALRES2 entry rather than two.

Step 4
Once you have entered all of the distribution system information, press Escape to get back to the Distribution Schedule: modify screen. The rest of the columns here are RDuct, Leak Test, ACCA design, Heating Fan, Cooling Fan, and Comment. Depending on your previous choices, some of these will be enabled, and you must fill them in.

RDuct means the R-value of the duct insulation you will be installing.

A Yes under Leak Test means that once your ducts are installed (no matter where), you will have them tested for air leakage, and they will comply with the maximum leakage allowed. You must have the air leakage test performed by a Home Energy Rating Systems (HERS) rater. If you intend to take the energy credit for this, move the cursor to the Leak Test column and either type in "Yes" or press Alt-C and select "Yes." Press Enter.

A Yes under ACCA design means you will design the duct system according to the Air Conditioning Contractors of American (ACCA) standards, which also allows an energy credit. Change the default entry No to Yes if you intend to design to ACCA standards and press Enter.

The Heating Fan and Cooling Fan columns are for the fan capacity(ies) in cubic feet per minute (CFM). You must fill in both columns even if you do not install both a heating and cooling system. Most of the time the CFM will be the same for both. You have the option of either using the default value or using the CFM rating of the actual mechanical unit. In using the default, you may sacrifice some energy credit. Press Enter if you type in a CFM.

Press Escape to get out of the edit mode. Press Enter to assign the new duct system to the heating or cooling distribution.

When you choose "Special" duct location, the related options must be specified on the *HERS Required Verification* list for verification by an approved HERS rater. There are several additional requirements when claiming these and other related credits. Detailed descriptions of these requirements are provided in Chapter 4 (Section 4.1) of the

Residential Manual.

All air-distribution system ducts and fans, including flexible insulated duct products, must comply with Section 150(m) of the Energy Efficiency Standards for Residential and Non-Residential Buildings.

All portions of the duct system in unconditioned space must be insulated to the minimum R-value used for compliance; weight-averaging of duct R-values is not allowed.

You receive energy credit when most or all of your ducts of a ducted HVAC system are installed in conditioned space. (There is no credit for systems that are normally installed without ducts such as floor and wall furnaces.) You can get credit for ducts inside conditioned space for two situations: 1) less than 12 linear feet of duct lie in unconditioned space; and 2) all ducts (and the air handler) are installed within the conditioned space. The first situation would typically apply to a ducted furnace or heat pump inside a garage with a relatively short duct run from the air handler to the conditioned space**.** Refer to the State Mechanical Code and your local building department for information on the types of heating systems that may be located within the sealed conditioned envelope of the building.

Instruction 4. Creating New Opaque Surfaces (wall, ceiling, floor)

You should create a new Construction record only if none of the assemblies already included in CALRES2 are applicable (the *Residential Manual*, describes the various typical construction assemblies). When you use a typical assembly, a Form 3R is not required for compliance documentation.

Step 1
Under the Lists menu, with the cursor on Opaque Surfaces, press Enter to bring up the Opaque Surfaces schedule. If you are working with a CALRES2 sample file, look in the Type column and move the cursor until you highlight a name matched with the type of surface you want to create (wall, ceiling, or floor). If you are working on an actual project file, use the line for which you want to create a special assembly. For the purposes of this example, choose Ceiling.

Step 2
Move the cursor to the Construct column and press Alt-C. This will open the Ceiling Construction Schedule. In the future when you choose Wall or Floor in Step 1, the Wall or Floor Construction Schedule will appear.

Step 3
Press Alt-M to modify the schedule. You will note that the assembly that was in the Opaque Surfaces schedule is highlighted. You may not be able to create a new assembly from here; in the Ceiling Construction Schedule, there are two base assemblies at the top of the list that you must choose from to create a new assembly. Similar base records exist on the Floor and Wall Construction Schedules. You can move to these by pressing the Page Up key or the up-arrow key until you are at the top of the list. Now you can press Alt-D (duplicate) to create a new line.

CALRES2 prompts you for a name for your new construction assembly. **You must name the new assembly by first typing USER followed by your own designation (such as USERceil)**. Press Enter.

Step 4
Now press Alt-W to open the Construction Layers Worksheet. In this worksheet you can edit an assembly. Creating a wall or floor is essentially the same as a ceiling assembly; we will stay with the example of a ceiling with references to special issues for walls or floors.

Step 5
All assemblies are modeled from individual components, and you will describe these components in order moving from the inside or conditioned side of the surface outward. The first component is the inside air surface film. Walls are automatically assigned 90 degree or vertical air films, ceilings 0 degree films, and floors 180 degree films. Most likely you can leave the default entry and move on; but if you need to change the

automatic assignment, which would apply mostly to a sloped ceiling, place the cursor on the row labeled #1 in the column called Material and press Alt-C. This will bring you into the Material Schedule. Using the arrow keys or page up/down, move the cursor until the appropriate "FilmIn" is highlighted and press Enter. The number following the "FilmIn_" indicates the degree of slope.

Now move the cursor over to the Framing column. Again, the default entry here may be the correct one, but if you wish to change it, press Alt-C to bring up the Construction Framing Schedule. Place the cursor on SurfaceFilm and press Enter.

Note that the rest of the columns for the surface film are automatically filled out.

Step 6
Now you are about to create the second layer of the new ceiling assembly. You should be in the Construction Layers Worksheet. With the cursor in the Material column, move the cursor down one row to the row labeled #2 and press Alt-C to bring up the Construction Layers Worksheet. Choose the material just as you did for the surface film: scroll to the correct material and press Enter. Scroll over to the next column, Framing, and using Alt-C, make any adjustments there. Press Enter then scroll to the next column, Thick. Enter the correct thickness in inches; you can just start typing the number and it will replace the existing entry. Press Enter. The rest of the columns generally fill in automatically.

Repeat until you have all layers entered, with the outside air film as the last layer (see Step 7).

Note: If you want to add more layers than are in the default file, press Alt-D, and if you want to delete a layer press Alt-Z.

Wall Assemblies. If you have a wall layer without framing you should choose Continuous from the Construction Framing Schedule. If the layer you are working on is a combination of cavity space and framing, select the appropriate framing spacing from the Construction Framing Schedule. When you select a framing percentage, another line is created. One line is for the information on the cavity and the other for the framing.

Metal frame assemblies cannot be calculated using CALRES2. If you have a metal assembly, you must use Easy Frame Version 2.0B to calculate it. You can then create an equivalent overall U-factor assembly in CALRES2. Be sure to include the documentation from Easy Frame in your permit application package submittal.

Note on Changing or Adding Materials. You can add or change the Material choices as follows: with the cursor on the Material column, press Alt-C to bring up the Materials Schedule. Then press Alt-M to modify the schedule. Press Alt-D to create a new line, and at the prompt type USER followed by descriptors of the material. You will note that under the source column a "U" is assigned to represent user defined.

Additional Note on Materials: In the Material Schedule, you can press Alt-M to make modifications. For a limited number of options in this screen, you can modify the column called Units to either per inch, total thickness in inches, or not having thickness as a scale. In this case, you must add the material's R- value or U-factor. The Conductance, Resistance, Density and Specific Heat values should be taken from ASHRAE and from the low end of the range. The only other option is independent lab tests, which must be submitted to the Energy Commission for review. The letter of review and the test results must be included in the building permit application.

Changing Framing Spacing

If one of the assembly layers is not continuous, such as the wood or steel framing in a framed wall or floor, then you must calculate the framing percentage as follows:

Step A
Calculate the framing percentage – that is, what percent of the square footage of an opaque surface contains framing members. You MUST account for top and bottom plates, fire blocks, window and door headers, sheetrock nailers, and shear supports in addition to the basic framing. Note that it is very important to properly document special framing percentages. You must provide a drawing of the layout. Table G-6 in the Glossary of the *Residential Manual* lists some typical framing percentages for standard-construction walls, floors, and roofs. You will use YOUR calculated percentage in Step D below.

Step B
In the Construction Layers Worksheet, place the cursor in the framing column and enter Alt-C. This will bring up the Construction Framing Schedule.

Step C
Press Alt-M and then move the cursor down to one of the pre-defined assemblies with percentages listed. Press Alt-D to duplicate a line and then enter a name for the new framing.

Step D
Move the cursor over to the percent framing and enter the percent you calculated in Step A. When you enter the framing percentage, the cavity percentage is automatically calculated. For your reference it is best to type a description of the framing in the Comment section to identify the application.

Press Escape and then Enter. This will assign the framing to the new assembly you are creating in the Construction Layers Worksheet.

Step 7
The last assembly component should be the outside air film. All assemblies except slab on grade must have an outside surface film. This is assigned in the same way that interior surface films are assigned.

Step 8
Once the entire assembly is complete, simply press the Escape key to get out of the Surface Worksheet, and press Escape again to take you out of the edit mode in the Floor, Ceiling, or Wall Schedule. Finally, press Enter to assign the assembly to the Opaque Surfaces schedule.

Notes about New Opaque Surface Documentation Forms

The construction worksheets calculate the overall U-factor of opaque surfaces, heat capacity and density of thermal mass elements. CALRES2 will automatically report this information on the C-2R. In addition, the nominal R-value of insulation will be reported on the CF-1R and C-2R. If you have opaque surface U-factors other than the default ones, you can generate Form 3Rs from the applicable Construction Schedule using Alt-P.

A Form 3R for each for each user-created construction assembly must be included with the permit application. Typical construction assemblies are protected and therefore are represented by U-factor alone and have no worksheets associated with them.

Instruction 5. Creating a New Fenestration Size

You just pressed Alt-M then Alt-D in the Frame Type schedule. CALRES2 prompts you for a name for your new fenestration entry; type in a name that will help you identify that piece of fenestration. We recommend using the standard shorthand for the dimensions of each rough opening; a window opening 3 feet 0 inches wide by 4 feet 10 inches high is abbreviated "30410." (Width always comes first.) After typing in the name, press Enter. The columns that appear in the Window Frame Schedule are **Name, Width, Height, Opening Type, Openable,** and **Comment**.

Name – you just typed in this name so scroll to the next column.

Width – enter the horizontal dimension of the window in feet and inches. If your window is 4 feet wide, simply type "4"; if it is, for example, 4 feet 3 inches wide, then type "4 3" (4 then a space then 3) then the right-arrow key. If you have a piece of glass in a door, add four inches to each dimension of the glass piece. For example, a glass window 2 feet wide and 1 foot 5 inches high in a door would be listed as 2 feet 4 inches and 1 foot 9 inches.

Height – enter the vertical dimension of the window in feet and inches. Use the same method of entering the dimensions as for width.

Reminder: Remember to look at the top of any screen for instructions for that screen and at the top and bottom of the screen for the commands available to you from that screen. Also remember to SAVE frequently (F2 key).

Opening Type – this describes how the window, door, etc., opens. Press Alt-C for the choices Slider, Hinged, Fixed, or Special. Assume Slider if you don't know.

Openable – this is automatically assigned; you can skip this column.

Comment – enter any notes you wish to make.

Press Escape three times to return to the Window Frame Type screen.

Instruction 6. Creating a New Glazing Type

Step 1

From the Glazing Type schedule, press Alt-M to be able to modify the schedule and then press Alt-D to create a new glazing type. In the name space provided, type in a name for the glass and press Enter.

Step 2
Move the cursor to the next column and if necessary change the number of panes of glass. Enter the value and press Enter.

Step 3
Move the cursor over to U-Wo, which is the U-factor of the window as a system (the frame and glazing, not just the glazing). Use the NFRC-rated U-factor of the fenestration product, or if the product does not have a NFRC rating then use the default table provided in the *Residential Manual*. Type in the number as a decimal (for example, ".44") and press Enter.

Step 4
Move the cursor over to the Type column and press Alt-C to bring up the Glass Type Schedule. This option can be left as clear since it is not used in the calculations. For documentation purposes, however, you may wish to select the appropriate glass type and press Enter.

Step 5
Move the cursor over to SHGC and enter the NFRC-rated value of the window as a system (the frame and glazing, not just the glazing). If you cannot get NFRC rating, use the default table in the *Residential Manual*.

Step 6
Move the cursor over to **ExtShade** and enter Alt-C to bring up the Exterior Shade Schedule. The options are as follows:

None -- SHGC 1.00
BugScrn – Bug Screen, SHGC 0.76
WvnScrn – Woven Screen, SHGC 0.30
LvrScrn – Louvered Screen, SHGC 0.27
LSASnScrn – Low Sun Angle Sun Screen, SHGC 0.15
RlDwnAwng – Roll-down Awning, SHGC 0.13
RlDwnBlnds – Roll-down Blinds, SHGC 0.13

Bugscreens can be assumed for all vertical glass even if none will be installed. The default assumption for skylights is None. If you select any other exterior shading,

CALRES2 adds the correct SHGC automatically. Be sure to press Enter if you modify the exterior shade. CALRES2 automatically prints the appropriate information on the C-2R report if the exterior shade selected is something other than standard bugscreen.

Step 7
The last step is to press the Escape key, which will highlight the entire line, then press Enter to assign the new window to the Fenestration Schedule.

Instruction 7. Notes on fins and overhangs

CALRES2 calculates the shading effect of fins and overhangs on glazing only, not on opaque exterior surfaces. You must use the following rules when modeling overhangs and fins:

- One overhang and two fins per wall are allowed. If there are two fins on a wall, *all* fenestration items must be between them. If you wish to model an elaborate fin system you must define the wall in segments. Call the Commission's Hotline for assistance with this process.
- Fins and overhangs can be attached only to vertical walls.

Use Overhangs to model the following:

- Roof eaves and porches. Describe the eave once on the wall, and CALRES2 will apply its shading to all of the windows on that wall.
- Balconies or floors that extend beyond the conditioned space and are above the dwelling unit you are modeling.

Use Fins to model the following:

- Garage or building walls that provide significant window shading.
  Wing walls separating units in a multi-family building. In this case, each unit would have a separate wall, with two fins, one on each side.

Instruction 8. Fenestration Placement

If you are modeling a building and not considering the impact of overhangs or fins, you do not have to worry about the placement of windows. The values on the Fenestration Schedule can be left alone.

Left D is the horizontal distance from the left edge of the wall to the left edge of the glazing, looking at the wall from the outside, as shown in Figure 4-10. This distance places the window geometrically on the wall. CALRES2 uses this information to determine the geometric relationship between the windows and the exterior shades input in the Fins/Overhangs List. CALRES2 calculates shading only for vertical walls. Units: feet.

HeadHt is the head height (height from the bottom of the wall to the top of the rough frames opening) of the window. This is used to determine the effect of fixed exterior shading on this window. Units: feet.

5.0 ADVANCED PROCEDURES AND SPECIAL COMPLIANCE TOPICS

The instructions in this chapter assume that you have opened CALRES2 and selected the sample file “sample.csv” as the basis for entering your building data.

Chapter 5 Contents

5.1 Water Heating

5.1.1 Creating New Domestic Water Heater (DHW) Systems

Use the DHW/Hydronic System Worksheet (Figure 5-1) to define the individual components of the domestic hot water, hydronic space heating, and combined hydronic systems. You may add as many records to the worksheet as necessary to describe the system (the sample file in Figure 5-1 shows only one record). Each **Item** in this worksheet represents a component of the water heating system. You reference each item to either a **Type** of water heater or to another component of the water heating system such as a hot water distribution system or a wood supplemental heating system.

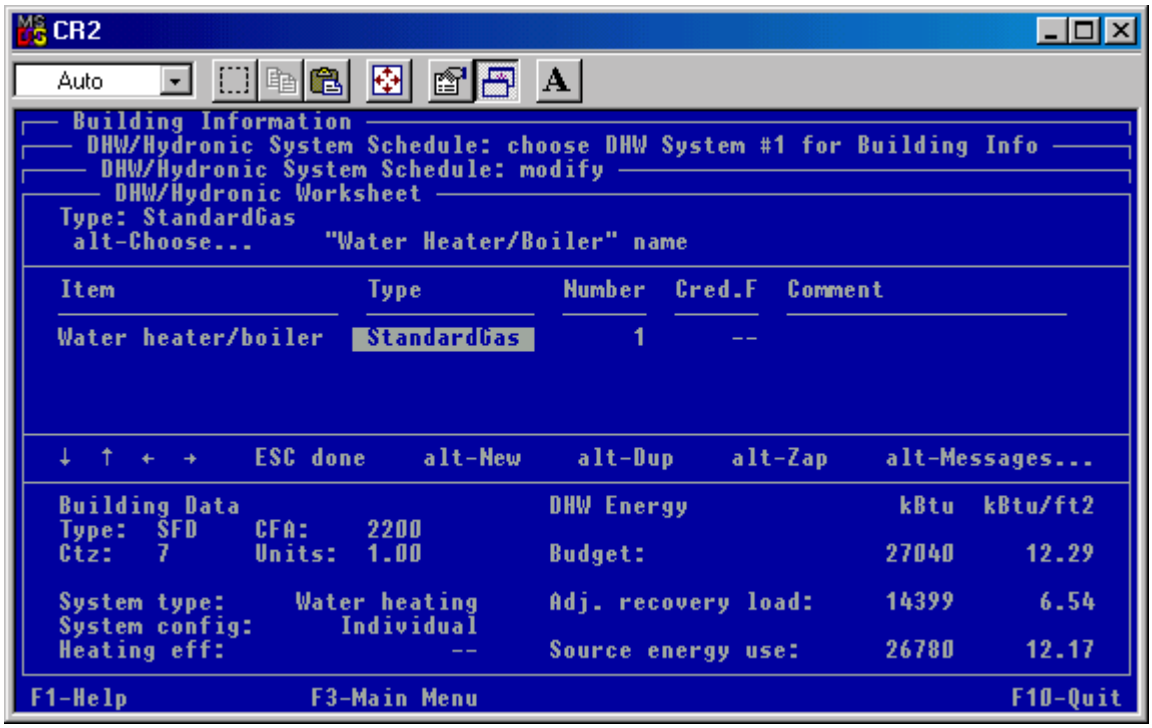

Figure 5-1. Sample DHW/Hydronic Worksheet

A results box at the bottom of the worksheet displays the annual energy use based on the components specified in the worksheet. The left side of the results box lists useful information such as building type, climate zone, and the standard compliance budget. The right side of the box lists the energy budget result for the system. If "??" appears in the DHW Energy fields, press Alt-M (for Messages) to access an Error List that displays the problems with the system that prevent a calculation.

Creating a new water heater system

Step 1
From the Lists menu on the main screen, scroll down to Building Info and press Enter. Scroll down to DHW System #1 or DHW System #2 and press Alt-C to open the DHW/Hydronic System Schedules. The options here are as follows:

- Standard Gas (natural gas water heater with Energy Factor 53% and with storage tank),
- Electric (electric water heater with storage tank),
- USER.58EF (natural gas water heater with Energy Factor 58% and with storage tank),
- USER.62EF (natural gas water heater with Energy Factor 62% and with storage tank), and
- Hydronic.

You are following these instructions because none of these standard options fits your planned water heater. To enter a new type of water heater into CALRES2, press Alt-M and then Alt-D to create a new line. At the prompt, type in a name for the system and press Enter. We suggest choosing a name that indicates the type of water heater and its efficiency. This will allow you to easily identify water heaters that you may use in the future. We have included a list of suggested names below (note that the efficiency rating of the unit is listed as part of the abbreviation):

Water Heater Types and CALRES Abbreviations	Suggested Names
Storage Tank, Gas-Fired, 52% Energy Factor (EF)	Standard_Gas
Storage Tank, Gas-Fired, 58% Energy Factor (EF)	GAS.58EF
Storage Tank, Gas-fired, 62% Energy Factor (EF)	GAS.62EF
Storage Tank, Oil-fired, 76% EF	STGOIL76
Storage Tank, Electric, 92% EF	Electric
Instantaneous Electric (Inst. Electric), 97% EF	INSTELE97
Instantaneous Gas (Inst. Gas), 72% EF	INSTGAS72
Heat pump, 3.5 HSPF	H20HP3.5
Large storage tank (> 75,000 Btu/h input), gas-fired, 82% EF	LGSTGGAS82
Boiler with tank (Boiler w/tank), 78% EF	BOILER-T78
Boiler (tankless), 88% EF	BOILER 88

Table 5-1. CALRES2 Water Heater Types, Abbreviations, and Suggested Names

Step 2
Once you have named the system, press Enter. Move the cursor to the **Type** column and press Alt-C. The choices for water heating system types are **Water heating, Space heating**, and **Combined hydronic**. Place the cursor on the appropriate choice and press Enter. If you are planning to install a combined hydronic system, which serves as both the hot water and space heating systems, complete these instructions and then refer to Section 5.2.1 in this chapter for the rest of the steps for combined hydronic systems.

If you are modeling a single system that serves multiple units, move the cursor over to **Config** and enter Alt-C. The choices under Configuration are Individual or Central. Place the cursor on Central and press Enter.

Step 3
You should be in the **DHW/Hydronic System Schedule: modify** schedule. Press Alt-W to access the **DHW/Hydronic Worksheet**. In the CALRES2 sample files, the first listing in this worksheet is **Water heater/boiler**. Make sure your cursor is on this line and in the **Type** column. Press Alt-C then Alt-M and finally Alt-D to create a new DHW system line. To be consistent, use the same name you used for the water heating system in Step 1. Press Enter after typing in the name.

Step 4
Move the cursor over to **Type** and press Alt-C. This will produce a list of water heater types. You may recognize them from Table 5-1 above. Select the appropriate one, press Enter, and look below for the rest of the instructions for your selection.

NOTE: If there is a value listed under a column, you must check this sample entry to see if it matches your planned system's specifications. If a question mark (?) appears in a column, you must fill in that value. If there is a dash in the column, you do not need to enter any data there.

Instructions for Storage Gas, Storage Oil, and Storage Electric Water Heaters

A.
Move the cursor over to "Vol" and enter the volume of the water heater. This is the number of gallons the unit is rated to store. If you do not know, you can use a generic 35, 40, or 50 gallon value, or if you know the model number you can go to the Energy Commission website and get the exact storage capacity.

B.
Move the cursor to the right one under "EF" and enter the unit's energy factor.

C.
Move the cursor over to RE (Recovery Efficiency). It is not necessary to change the default value here, as it will not affect the energy budget. You may enter the information if you wish.

D.
Place the cursor under Input; the units are kBtu/h. It is not necessary to change this value either, but you can if you wish. [For electric units, you must convert the kW rating into kBtu/h (kW rating x 3.413 = kBtu/h.)]

E.
Once you have entered all of the data and checked the information, press Escape and then press Enter. This will assign the new water heater to the Type of unit in the DHW/Hydronic worksheet. If all the information is complete here, press Escape twice and then press Enter. This will assign the water heater system to DHW System #1 or 2.

Instructions for Instantaneous Gas and Instantaneous Electric Water Heaters

A.
Move the cursor over to Recovery Efficiency "RE" and type in the value. If you do not have it, you can call the Commission Hotline.

B.
Place the cursor under Input; the units are kBtu/h. It is not necessary to change this value either but you can if you wish. [For electric units, you must convert the kW rating into kBtu/h (kW rating x 3.413 = kBtu/h.)]

C.
For a gas heater only, move the cursor over to Pilot and enter the pilot light energy use per hour. If you can't locate this information, use 800 Btu/h.

D.
Once you have entered all of the data and checked the information, press Escape and then press Enter. This will assign the new water heater to the Type of unit in the DHW/Hydronic worksheet. If all the information is complete here, press Escape twice and then press Enter. This will assign the water heater system to DHW System #1 or 2.

Instructions for Heat Pump Water Heaters

A.
Move the cursor over to **Vol** and enter the volume of the water heater. This is the number of gallons the unit is rated to store. If you do not know, you can use a generic 35, 40, or 50 gallon value, or if you know the model number, you can either check the appliance database on the Energy Commission's website or call the Hotline with the model number.

B.
Move the cursor to the right one under **EF** for energy factor and enter the unit's energy factor.

C.
Place the cursor under **Input**. It is not necessary to change the default value here, as it will not affect the energy budget. You may enter the information if you wish. The units are kBtu/h. [For electric units, you must convert the kW rating into kBtu/h (kW rating x 3.413 = kBtu/h.)]

D.
Once you have entered all of the data and checked the information, press Escape and then press Enter. This will assign the new water heater to the Type of unit in the **DHW/Hydronic** worksheet. If all the information is complete here, press Escape twice and then press Enter. This will assign the water heater system to DHW System #1 or 2.

Instructions for Large Storage Gas-Fired Water Heaters (>75,000 Btu/h or 75 kBtu/h input)

A.
Move the cursor over to **Vol** and enter the Volume of the water heater. This is the number of gallons the unit is rated to store. You can use a generic 35, 40 or 70 gallon value, or if you know the model number, you can either check the appliance database on the Energy Commission's website or call the Hotline with the model number.

B.
Move the cursor to the right under **RE** for Recovery Efficiency and enter the water heater's recovery efficiency. Note that if you are planning to install a combined hydronic space/water heating system, you must select Large Storage Gas for the water heater type even if you are using a boiler. In this case the AFUE for the boiler can be substituted for RE. The reverse applies if you are modeling a hydronic space heating system: even if you are using a Large Storage Gas unit, you must model it as a Boiler, and the RE of the unit can be substituted for the AFUE.

C.
Place the cursor under **Input**. You MUST change the kBtu/h input for large storage gas systems.

D.
Move the cursor over to **SL** or Standby Loss. Enter the standby loss of the unit. If you are planning to install a boiler, you can assume a standby of 3.5. Press Enter.

E.
Move the cursor to the **R Tank** (R-value of the storage tank) column. If you plan to install a boiler and storage tank, or a tank alone where the water is heated, we strongly recommend that for compliance using CALRES2, you wrap the hot water tank with R-12 insulation and model it that way. You would type 12 in this column and press Enter. If you plan to use a boiler with no storage tank, then also type 12 here and press Enter.

F.
Once you have entered all of the data and checked the information, press Escape and then press Enter. This will assign the new water heater to the Type of unit in the **DHW/Hydronic** worksheet. If all the information is complete here, press Escape twice and then press Enter. This will assign the water heater system to DHW System #1 or 2.

Instructions for Boiler and Boiler with Tank Water Heaters

A.
Place the cursor under **AFUE** (Annual Fuel Utilization Efficiency) and enter the unit's efficiency rating. If you are modeling a hydronic space heating system and are using a large storage gas water heater, you must enter the Recovery Efficiency rating for the AFUE.

B.
Place the cursor under **Input**. You MUST change the default value if you are planning to install a large storage gas system (>75,000 Btu/h or 75 kBtu/h input). If you have a model number for the unit, you can call the Commission Hotline for find its input rating.

C.
Move the cursor over to **Pilot** and enter the pilot light's energy use per hour. Note that if you are using a large storage gas water heater in a hydronic space heating system, you should enter 100 unless the value is actually known. This data can be found by calling the Commission Hotline.

D.
Move the cursor to the **R tank** column and enter the R-value for the external tank insulation on the water heater. If you are using a boiler with a tank then input the external R-value here as would be done with a large storage gas unit. If you are using a boiler with no storage tank then type 12 here and press Enter.

E.
Once you have entered all of the data and checked the information, press Escape and then press Enter. This will assign the new water heater to the Type of unit in the **DHW/Hydroni**c worksheet. If all the information is complete here, press Escape twice and then press Enter. This will assign the water heater system to DHW System #1 or 2.

5.1.2 Multiple Water Heating Systems

You may specify up to two water heating systems. Describe each in the DHW/Hydronic System worksheet. CALRES2 automatically follows the averaging instructions from the water heating method described in the *Alternative Calculation Methods Approval Manual*.

Note: Each water heating system may have one or more water heaters, but they must be of the same type (e.g., storage gas). Additionally, each water heating system may have only one distribution system type (see the *Residential Manual*, Chapter 6, for more information).

How to model multiple water heaters (single-family and multi-family dwellings)

The following steps describe how to model multiple water heaters of the same type.

Step 1
On the CALRES main menu, go to **Lists**, place the cursor on **Building Information**, and press Enter. Move the cursor down to DHW System #1 and press Alt-C to open the DHW/Hydronic schedule.

Step 2
Enter Alt-M to be able to edit the schedule.

Step 3
Move the cursor to the row of the water heater that is in your building plans. Press Alt-W to bring up the **DHW/Hydronic Worksheet**. Move the cursor to the **Number** column and type in the number of water heaters for each unit. For example, you may have two water heaters in a single family home – so the value would be 2, but if you had a 26-unit apartment complex with one water heater for each unit, the number here would be 1. (Be sure that you have multi-family as the building type and the number of dwelling units is correct.)

How to Model Multiple Water Heaters of Different Types

The following steps are for multiple water heaters of different types.

Step 1
From the **Lists** menu, move the cursor down to **Building Information** and press Enter. Move the cursor down to DHW System #1 or #2 (depending on which system you are changing), then press Alt-C to get into the DHW/Hydronic System Schedule.

Step 2
Press Alt-M to be able to modify the **DHW/Hydronic System Schedule** and then Alt-D to create a new line. At the prompt, type in a name for the water heater referencing the type of water heater and/or the efficiency. For example, if you are putting in a large storage gas water heater with a recovery efficiency of 87%, then the name might be "LgStgGas87." Once you have typed the name, press Enter. This new name should appear on a new line containing some default information. Note that whatever line your cursor is on when you press Alt-D provides the starting (default) information for the new line you create.

Step 3
Now that the new line is created, the information in that line must be modified to match your equipment specifications. If the unit is to be used only for water heating and for an individual unit, press Alt-W to get into the **DHW/Hydronic Worksheet**.

Step 4
To change the type of water heater, have the cursor in the **Type** column and press Alt-C. This will bring up the **Water Heater/Boiler Schedule**. Press Alt-M then Alt-D to create a new line. At the name prompt, type in either the same name you just used in the DHW/Hydronic Schedule or you any other descriptive name. Press Enter.

Step 5
Move the cursor to the right under **Type** and press Alt-C. This will bring up the Type menu, which lists a number of different types of water heaters. Move the cursor until you highlight the type of water heater system you plan to install and then press Enter. You might notice that some of the values to the right changed. These are only default assumptions — be sure to change each value that doesn't match the specifications for your proposed unit. Section 5.1.1 above lists instructions for filling in the rest of the columns in this schedule, according to the type of water heater. The columns are **Volume,** Energy Factor (**EF**)**,** Recovery Efficiency (**RE**)**, AFUE, Input, Pilot,** Standby Loss (**SL**)**,** and **R-tank** (R-value of water tank insulation) (to fill in these columns, see the appropriate set of instructions within the boxes in Section 5.1.1.)

Step 6 (This is a redundant step if you used Section 5.1.1)
Once you have entered the correct data, press the Escape key and then press Enter to assign the new water heater into the **DHW/Hydronic Schedule**. Then press Escape and then Enter again to assign the water heater to the **Building Information**.

5.1.3 Adding Special Water Heating Distribution Systems

Water heating systems may be designed with special types of distribution systems. While we cannot cover all of the options, we will discuss how to make each type of modification to an input file.

How to modify DHW distribution systems

Step 1
From the Lists menu, move the cursor down to Building Information and press Enter. Move the cursor down to DHW System #1 or #2 (depending on which system you are changing), then press Alt-C to get into the DHW/Hydronic System Schedule.

Step 2
Press Alt-M to be able to modify the DHW/Hydronic System Schedule and then Alt-D to create a new water heating system. At the prompt, type in a name for the water heater referencing the type of water heater and/or the efficiency. For example, if you are putting in a large storage gas water heater with a recovery efficiency of 87%, then the name

might be “LgStgGas87.” Once you have typed the name, press Enter. This new name should appear on a new line containing some default information. Note that whatever line your cursor is on when you press Alt-D provides the starting (default) information for the new system you create.

Step 3
Now that the new line is created, the information in that line must be modified to match your equipment specifications. If the unit is to be used only for water heating and for an individual unit (rather than a central unit for multiple dwelling units), press Alt-W to get into the DHW/Hydronic Worksheet.

Step 4
You should have just pressed Alt-W to bring up the DHW/Hydronic Worksheet. Assuming that you are not changing the water heater type, press Alt-D to create a new line. Move the cursor to the Item column and press Alt-C. This brings up a menu of distribution options including water re-circulation systems, credits for wood stove boilers, hydronic terminals, and solar water heating. Chapter 6 of the *Residential Manual* has information of how each of these systems work.

ABBREVIATION	**WHAT IT STANDS FOR (more information in Chapter 6 of the *Residential Manual*)**
Dist: Standard	Typical duct distribution
Dist: PtofUse	Point of Use
Dist: HtWtrRcv	Hot Water Recovery
Dist: PipeInsl	Pipe Insulation
Dist: Parallel Piping	Parallel Piping
Dist: RecrcNC	No control/ continuous
Dist: RecrcTim	Time-controlled recirculation
Dist: RecrcTmp	Temperature-controlled recirculation
Dist: RecrcT&T	Timer- and temperature-controlled recirculation
Dist: RecrcDmd	Recirculation upon hot water demand
Dist: R/D&HWR	Demand plus hot water recovery
Dist: R/D&Pins	Demand plus pipe insulation
Credit: WSB	Wood stove boiler
Credit: WSB w/pump	Wood stove boiler with pump
Credit: Active slr	Active solar
Credit: Passive slr	Passive solar

Select the item that is in your plans and press Enter. With the exception of the Solar Fraction for Solar Hot Water heating, no other entries are required. Press Escape twice then press Enter to assign your new distribution system.

5.1.4 Modeling Solar Water Heating

Steps 1-5
For modeling solar water heating, follow the same steps as in Section 5.1.3 above. Note that the table above in Step 4 includes active and passive solar water heating. Select the appropriate one and press Enter. (NOTE: if you have a nonstandard distribution system AND solar hot water, you need to have a line for each. Use Alt-D to duplicate a line.) You will note that there is now a question mark (?) in the Cred. F column. Here you need to fill in the solar fraction. To obtain the solar fraction for either type of solar system refer to the *Residential Manual*, Chapter 6, Section 6.3, DHW-4 and Table 6-8).

Step 6
After you have entered the solar fraction, press Enter and then Escape to assign the credit to the DHW/Hydronic worksheet. Then press Escape and Enter again to assign the system to the DHW/Hydronic Schedule. Press Escape and then Enter to assign the new water heating system to either DHW System #1 or #2, depending on where you started.

5.2 Hydronic Systems

5.2.1 Combined Hydronic Space and Water Heating Systems

A combined hydronic system serves both water and space heating with a single water-heating appliance. While boilers may be used for combined hydronic systems, you cannot use their efficiency ratings in CALRES2. If you use a boiler, it must be modeled as a large storage gas water heater.

To model a combined hydronic heating system using CALRES2, you will need to make entries through both the Building Information schedule and the Zones schedule from the main Lists menu. NOTE: If you plan to use a radiant floor system to distribute the space heating and the floor is a slab on grade, **you must install insulation around the perimeter of the slab**; the R-value needed to comply with energy standards depends on your climate zone and how you install the insulation. See Chapter 8, Section 8.8, of the *Residential Manual* for details. Because of a peculiarity in CALRES2, **you must model the slab as having no perimeter insulation**.

How to Model a Combined Hydronic System

Step 1
From the main CALRES2 menu, have the cursor on Lists. Scroll down to Building Information and press Enter. Scroll down to DHW System #1. Press Alt-C, then Alt-M, then Alt-D to create a new line of data.

Step 2
At the name prompt, type in Chydro or any other appropriate name and press Enter.

Step 3
Move the cursor to the Type column and press Alt-C, then select Combined hydronic and press Enter.

Step 4
Scroll over to the Config column. Press Alt-C. Move the cursor to Individual if the system is for an individual dwelling or Central if the system will serve multiple dwelling units in a building. Press Enter.

Step 5
Press Alt-W to bring up the DHW/Hydronic Worksheet.

Step 6
Press Alt-D to create a new data line. With the cursor on the new line and in the Item column, press Alt-C and then move the cursor to Hydronic Terminal. Press Enter.

Step 7
Move the cursor to the Type column and press Alt-C, which will bring up the Hydronic Terminal Schedule. The three options here are BaseBoard, FanCoil, and radiant. Move the cursor to the option that you are planning to install. Press Alt-M to be able to fill in the rest of the columns, as follows:

> Move the cursor over to the PipeL column. Type in the number of feet of pipe form the supply to the distribution system (terminals). Press Enter.
>
> Move the cursor over to the Pipe D column and type in the diameter of the pipe in inches. Press Enter.
>
> Move the cursor to the PIns T column and type in the pipe insulation thickness (in inches) to indicate the pipe insulation thickness you are planning to install. Press Enter
>
> Move the cursor to the PIns k column and type in the pipe insulation conductivity [the units are Btu(in)/h(ft^2)°F]. Press Enter. If you can't locate this information, use the default value.

Press Escape.

Step 8
You should now be back at the DHW/Hydronic worksheet. Move the cursor to the Number column. For most situations, the number should be left as 1, but for example if you have radiators, then you must enter the actual number of radiators. If you type in a new number, be sure to press Enter.

Step 9
The next procedure is to input the appropriate water heater. Move the cursor to the line for Water heater/boiler in the Type column and press Alt-C.

The choices that come in the sample file are Standard Gas (natural gas water heater with a water tank, energy factor of 52%), Electric (electric water heater with a water tank), USER.58EF (natural gas water heater with tank, energy factor of 58%) and (USER.62EF (natural gas water heater with tank, energy factor of 62%). If one of these matches your planned system, move the cursor to the one you plan to install and press Enter. If none of the choices fit your situation, follow these steps to create a new type of water heater:

a. Press Alt-M to be able to modify the schedule followed by Alt-D to create a new line.
b. Type in a name for the water heater (twelve characters maximum) and press Enter.
c. Move the cursor to the Type column and press Alt-C. Choose from the options and press Enter.
d. Go to each column and type in information as appropriate. The column headings are as follows: Vol (tank volume in gallons), EF (energy factor), RE (recovery efficiency), AFUE (Annual Fuel Utilization Efficiency), Input (equipment fuel input rate in kBtu/h), Pilot (gas pilot consumption in Btu/h), SL (Standby loss), R tank, (Tank insulation R-value), and Comment (an optional entry).
e. Press Enter after your last entry.

Step 10
Try pressing Enter again to make sure your data have been entered; if CALRES2 won't accept Enter, press Escape. To assign the combined hydronic system to Building Information, press Escape again to highlight the entire line on the DWH/Hydronic Schedule and then press Enter. The name of the hydronic system should now appear after DHW#1 on the Building Information schedule.

Step 11
The next series of steps assigns the combined hydronic system to the space heating schedule. In the Building Information screen, press Escape. This should put you back to the Lists menu. Move the cursor down to Zones and press Enter.

Step 12
Move the cursor over to HVAC system and press Alt-C to bring up the HVAC System Schedule. Press Alt-M and then Alt-D to duplicate a line. Type in "Chydro" for the name and press Enter.

Step 13
Move the cursor over to HTEqType and press Alt-C. Move the cursor down until it is on Combined hydronic and the press Enter. This will bring you back to the HVAC system schedule: modify screen.

Step 14
Move the cursor to HeatEquip and press Alt-C to bring up the DHW/Hydronic Schedule with the Chydro system that you just created for the DHW#1. Place the cursor on this line and press Enter.

Step 15
Move the cursor over to HeatDist. If you are using a fancoil unit, you may use the COMMISSION default that's entered here, or you can create a special distribution system (Alt-C then Alt-M then Alt-D and fill in the columns). If you are using radiant floor or baseboard heaters, type in "None."

> **NOTE**: if you are modeling a combined hydronic system that uses radiant floor heating in a slab, then the building must be modeled with no perimeter insulation on the slab. **However, insulation must be installed** (details on insulation levels for the various climate zones are located in Section 8.8 of the *Residential Manual*).

Step 16
Press Enter if you made changes then press Escape several times until you're back at the Lists menu.

5.2.2 Hydronic Space Heating

Hydronic space heating systems use boilers, storage tanks, mechanical circulation devices, distribution terminals (for example, a fan coil serving an air distribution system), radiators, or radiant systems. These systems are dedicated space heating systems, and the building will have a separate water heater dedicated to domestic hot water. In situations where a large storage gas-fired or other type of water heater is being used, it must be modeled as a boiler for CALRES2 to work. You can assume "AFUE" and "Recovery Efficiency" to be the same. You may have to look up the pilot light energy or external tank insulation in the manufacturers' data or by contacting the Commission's Hotline.

> **NOTE**: If you plan to use a radiant floor system to distribute the space heating and the floor is a slab on grade, **you must install insulation around the perimeter of the slab**; the R-value needed to comply with energy standards depends on your climate zone and how you install the insulation. See Chapter 8, Section 8.8, of the *Residential Manual* for details. Because of a peculiarity in CALRES2, **you must model the slab as having no perimeter insulation**.

Modeling a Hydronic Space Heating System

Note: When modeling a hydronic system that is exclusively for space heating, you enter the data for the space heating system only under **HVAC System** in the **Zones** schedule. You separately list your domestic hot water system in the Building Information schedule under DHW System #1. Refer to Chapter 4 under Building Info for entering data on the domestic water heater.

Hydronic Space Heating

Step 1
From the CALRES2 main menu, start in Lists, scroll down to Zones and press Enter. Scroll to the HVAC System column and press Alt-C. Move the cursor to the Hydronic line and press Enter. Skip down to **Step 2** if you are modeling a system serving an individual dwelling unit.

> **NOTE**: the default configuration for hydronic systems in the CALRES2 sample file is for a system serving an individual dwelling unit. If your system is a hydronic space heating unit serving as a central system for more than one dwelling, you must change the configuration as follows:
>
> a. In the Zones screen, have the cursor in the HVAC System column, which should say Hydronic. Press Alt-C.
> b. Press Alt-M. Scroll over to the HtEqType column. Press Alt-C. Move the cursor to Hydronic and press Enter.
> c. Move the cursor to HeatEquip, then press Alt-C then Alt-M then Alt-D. Type "Hydronic" at the name prompt and press Enter.
> d. Move the cursor to the Type column, press Alt-C, choose Space Heating, and press Enter.
> e. Move the cursor to Config, press Alt-C, choose Central, and press Enter.
> f. Press Escape then press Enter to assign the data. You should be in the HVAC System Schedule: modify screen.
> g. Again press Escape and then Enter. You should be back in the Zones screen, with the cursor in the HVAC System column. You can now continue defining your hydronic space heating system by going to Step 2.

Step 2
You should be in the Zones screen, with the cursor on Hydronic. Press Alt-C then Alt-M. Move the cursor to the HeatEquip column.

Step 3.
Press Alt-C again then Alt-M again.

Step 4.
Press Alt-W. Place the cursor on the Hydronic Terminal line, in the Type column. Press Alt-C. The three options here are Baseboard, Fan-coil, and Radiant. Move the cursor to the correct one and press Alt-M.

Step 5.
Move the cursor over to the PipeL column. Type in the number of feet of pipe from the supply to the distribution system (terminals). Press Enter.

Move the cursor over to the Pipe D column and type in the diameter of the pipe in inches. Press Enter.

Move the cursor to the PIns T column and type in the pipe insulation thickness (in inches) to indicate the pipe insulation thickness you are planning to install. Press Enter.

Move the cursor to the PIns k column and type in the pipe insulation conductivity [the units are Btu(in)/h(ft^2)°F]. Press Enter. (If you can't locate this information, use the default value.) Press Escape once then press Enter.

Now you must input the appropriate water heater for your hydronic space heating system.

Step 6
You should be in the DHW/Hydronic Worksheet. Starting here, move the cursor so it is on the Water heater/boiler line, in the Type column. Press Alt-C, then Alt-M then Alt-D to create a new line. At the name prompt, type in "Boiler" and press Enter.

Go to the Type column, press Alt-C and select either Boiler with tank or Boiler (it does not matter which). Press Enter.

Step 7
Move the cursor to the AFUE column and enter the unit's efficiency rating. If you are using a large storage gas water heater (>75,000 Btu/h input), you must enter the Recovery Efficiency rating for the AFUE.

Step 8
Place the cursor under Input. You MUST change the default value if you are planning to install a large storage gas water heater. If you have a model number for the unit, you can find its input rating by calling the Commission's Hotline.

Step 9
Move the cursor over to Pilot and enter the pilot light's energy use per hour. Note that if you are using a large storage gas water heater, you should enter 100 for the pilot unless the value is actually known. This data for many models can be found by calling the Commission's Hotline.

Step 10
Move the cursor to the **R Tank** (R-value of the storage tank) column. If you plan to install a boiler and storage tank (or a tank alone where the water is heated) we strongly recommend that for compliance using CALRES2, you wrap the hot water tank with R-12 insulation and model it that way. You would type 12 in this column and press Enter. If you plan to use a boiler with no storage tank, then also type 12 here and press Enter.

Step 11
If you wish to record a comment, move the cursor to the Comment column and type it in. Press Enter.

Step 12
Press Escape. To assign your system to the building, press Escape again to highlight the entire line on the DWH/Hydronic Schedule and then press Enter. The name of the hydronic system should now appear under HeatEquip in the Zones schedule.

Step 13
If you are modeling a hydronic system that uses radiant floor heating in a slab, you must model the building with no perimeter insulation on the slab edge. [**However, slab perimeter insulation must be <u>installed</u> for hydronic systems with radiant floor heating in the slab** (see Section 8.8 of the *Residential Manual* for details). This is a peculiarity in CALRES2 where the model and the actual installation do not match.] Go to the Perimeter schedule under the Lists menu. Make sure there is a "0" in the **EdgeRval** column. There is one exception: if you are building in Climate Zone 16 and your building plans already include perimeter slab insulation of R-7, type "7" in the **EdgeRval** column.

> **NOTE**: in the future, you may be working from one of your own files rather than the CALRES2 sample file. Note that you should not use Alt-D when your cursor is on **Large storage gas** in the **Water Heater/Boiler Schedule**. (This is a peculiarity in CALRES2 and will create an error in your file that will be hard to correct.)

5.3 Zones

5.3.1 Multiple Conditioned Zones: Living and Sleeping

The principle of zonal control is that the building will use less energy because you can turn off the space conditioning to rooms (zones) that are not in use while maintaining the space conditioning in rooms that are in use. Multiple conditioned zones can be modeled in CALRES2 only if all the criteria for the zonal control credit are met (refer to the *Residential Manual* Glossary under Zonal Control). A Commission-approved thermostat schedule corresponding to this concept is a fixed simulation schedule within CALRES2.

> **NOTE**: if the nonclosable opening between the two zones is more than 40 square feet, you cannot take this credit.

To use zonal control, you must first divide the house into two separate zones: living and sleeping. Then you assign the characteristics of the house to the corresponding zone. From the Zones list, you must reference the COMMISSION fixed simulation schedules for each corresponding zone. The elements in the Opaque Surfaces List reference the zone each element is in. Boundary walls between the two zones are entered once in the List, with the exterior condition set to "Adjacent Zone."

The zonal control HVAC system design uses fully-closeable distribution dampers, thermostats that control the zones, and total non-closeable openings between zones (entered in the Interzone Vent schedule) which total no greater than 40 square feet.

Modeling a Living and Sleeping Zone

Step 1
From the Lists menu, move the cursor down to Zones, press Enter then Alt-D to duplicate a line. At the name prompt, type in 'Sleeping' and press Enter. Press Alt-D to create another new line, and this time type 'Living' at the name prompt.

Step 2
Move the cursor over to the right to the SimZonCond column. Then press Alt-C to bring up the Zone Condition Schedules and move the cursor down to COMMISSION-Living for the living zone and press Enter. Duplicate this process for the sleeping zone by placing the cursor on COMMISSION-Sleeping and pressing enter. Change the floor areas, ceiling height and HVAC system for each of the zones to reflect the plans. This completes the modification needed under zones.

Step 3
Move the cursor down to opaque surfaces and press Enter. In this schedule you must create each of the surfaces that bound each zone. Create new walls, floors, or ceilings as described in Chapter 4. Once you have complete the description place the cursor on zone, enter Alt-C which will move you back to the Zone schedule and press enter to assign that surface to the proper zone.

Step 4
To create the boundary between the two zones you need to select a wall, interior ceiling or even a combination of the two to represent the boundary. Create a new line for this by entering Alt-D and in the name space provided type in **INTERZONE**. If you have more than one, you can number the surfaces. Enter in the type, square footage, orientation, and construction type of the surface. Since these are usually interior surfaces, there will most likely be no insulation.

Step 5
Place the cursor on zone and assign the zone to the Living zone. Next move the cursor to exterior condition and enter Alt-C. Select Adjacent zone and press Enter. Finally move

the cursor one more space to the right under Adjacent zone and press Alt-C, which will bring you back to the Zone Schedule. Place the cursor on the Sleeping zone and press Enter. If all the surfaces in the building are assigned and you have created a partition between the two zones, you have completed the work in the Opaque surface section.

Step 6
The next step is to move the cursor down to Interzone Vent. Return to the Lists menu on the main CALRES2 screen and scroll to Interzone Vent. In most files this schedule is empty. Press Alt-N to create a new line. At the name prompt, type in INTZONE and press Enter.

Step 7
Move the cursor over to the Type column and press Alt-C. Place the cursor on COMMISSION Nonclosable Opening and press Enter. Move the cursor over to Surface and press Alt-C; this will take you back to the Opaque Surface Schedule. Place the cursor on the Interzone partition you created in Opaque Surfaces and press Enter.

Step 8
The final step is to enter the size of the opening between the two zones. Note that if the total nonclosable opening between the two zones is more that 40 square feet you cannot take this credit. If this is the case you must model the building as a single conditioned zone. Once you have entered the square footage, press Enter.

Step 9
Hit escape to return to Lists; this should complete the inputs for a living and sleeping zone building.

Note: You are not allowed to model two zones, the Living and Sleeping zone, if you have an opening of more than 40 square feet between these two zones. Instead, model the house as a single zone (no matter how many air conditioning or heating systems you are using).

5.3.2 Interzone Vent

The Interzone Vent schedule is accessed from the Lists menu on the main CALRES2 screen. You use it only when modeling Living and Sleeping Zones or a house with a sunspace. Without an Interzone Vent, CALRES2 cannot treat the exchange of air between the two zones correctly.

The steps for Living and Sleeping Zones are covered in the previous section, 5.3.1, starting at Step 6. For sunspaces, call the Hotline.

5.3.3 Controlled Ventilation Crawlspace

A controlled ventilation crawl space is a building technique that reduces overall energy use in a house by reducing airflow through the crawl space beneath the house. You must meet special installation criteria, such as the following:

- Installation of temperature-actuated crawl space vent dampers
- Special attention to drainage around the crawl space
- Installation of a vapor barrier on the crawl space ground
- Installation of insulation around the perimeter stem wall instead of under the floor between the floor joists.

Refer to the *Residential Manual*, Appendix G, for a more detailed description of the controlled ventilation crawl space requirements.

> **NOTE**: Basements and garages are not crawl spaces and are not eligible for the controlled ventilation crawl space modeling approach.

If your building meets the criteria for the controlled ventilation crawl space, you may model the crawl space as an unconditioned zone in the Zones List. You model the floor in the Opaque Surfaces schedule as part of the conditioned zone and set the adjacent zone to CVC. You must modify the floor U-factor worksheet to reflect the omission of insulation between the floor joists. You will also need to complete the specifications for the CVC zone. Since this is a separate zone, you model the foundation stem wall as a wall in the Opaque Surfaces schedule. The soil is modeled using the material CVCSoil. The Material and Floor Construction Schedules include this information. You model the perimeter of the crawl space in the Perimeter schedule. Step-by-step instructions are below.

How to model a Controlled Ventilation Crawlspace

Step 1
In the Lists menu, scroll to Zones, and press Enter. There should be only one zone, most likely called House.

Step 2
Press Alt-D to duplicate a line. At the name prompt, type in **CVC** and press Enter.

Step 3
With the cursor on the name, move over to the Type column and press Alt-C to get into the Type schedule. Move down to CVC and press Enter.

Step 4
Move the cursor over to the Floor Area column and type the square footage of the CVC zone. Press Enter.

Step 5
Move to the ClgHtg (ceiling height) column. Type in the height of the crawlspace in feet — as a whole number, as a decimal, or in feet and inches. For example, type "1" for one foot even, type "1.5" for 18 inches (same as one and a half feet). For one and a half feet, you can also type "1 6" (1 then a space then 6 for one foot six inches). Most crawlspaces are at least 18 inches high. If you do not know the exact height of the crawlspace you can simply enter two feet. Press Enter. CALRES2 will automatically calculate the volume of the crawlspace, so you can skip that column and scroll to the Sim ZoneCond column.

Step 6
With the cursor under the Sim ZoneCond column, press Alt-C. Move the cursor to COMMISSION_CVC and press Enter. The next three columns, HVAC System, HtEff, and ClEff, should appear as dashes. If you wish to record a comment, scroll to the Comment column, type in your remarks, and press Enter.

Step 7
Press Escape to get back to the Lists menu and scroll down to Opaque Surfaces. Press Enter.

Step 8
Scroll down to Raised Floor and then scroll to the right (off the screen) to the Ext Cond column. Press Alt-C.

Step 9
Move the cursor down until it is on Adjacent zone. Press Enter and then move the cursor to the Adj Zone column, which might be off the screen. Press Alt-C to put you back into the Zones schedule. Make sure the cursor is on the CVC line and press Enter. (The only other zone should be the conditioned zone for the HOUSE.)

Step 10
You should be in the Opaque Surfaces screen. Move the cursor back to the Type column (it might be off screen) and up to a row for an existing wall (it is best to use the last conditioned wall). Press Alt-D to duplicate the line and then enter a name for the first wall around the CVC; for example, call it CVCNorth. Press Enter. Press Alt-D again to duplicate the line and call this one, for example, CVCEast, and press Enter. Repeat this operation until you have created and named all the walls that enclose the CVC. (If needed, instructions on how to create new wall, floor, or ceiling assemblies can be found in Chapter 4, Instruction 3.)

Step 11
Press Alt-D one more time to create a line to describe the floor of the CVC. Name this one CVCFloor and press Enter. In the Type column for this line, press Alt-C and move the cursor to Floor and press Enter.

Step 12
Now you must fill in all the appropriate columns that go with each of the CVC's opaque surfaces – that is, each of the walls you just created and the CVC floor.

The floor of the CVC should be modeled with COMMISSION_CVCSoil as the assembly, CVC as the Zone, and Grade as the exterior condition.

> **NOTE**: When modeling a CVC, check the Perimeter schedule in CALRES2 (accessed from the Lists menu of the CALRES2 main screen) and be sure that the Length column says 0. Exception: if your building has a separate portion that does have a slab, model the slab perimeter here in the Perimeter list. Similarly, be sure that the Interzone Vent schedule (also accessed from the Lists menu in the main screen) contains no data unless you are modeling the house with a Living and Sleeping zone.

5.4 Multifamily Buildings

CALRES2 offers two options for modeling multifamily buildings: Unit-by-Unit and Whole Building.

5.4.1 Unit-by-Unit

When using this compliance option, each dwelling unit in the multifamily building must comply with the standard energy budget that CALRES2 will calculate.

Follow the instructions for modeling a single family dwelling in Chapter 4. You will need to run CALRES2 for each individual dwelling unit (except that you may run the model once to cover a number of units that are identical in size, energy-related features, and orientation). You must run separate calculations for all the orientations of any given unit and for each placement – that is, end unit versus middle unit, and placement on a top, middle, and bottom floor.

You do not need to input the walls or ceiling areas with conditioned space on both sides (such as the common wall between apartments), but you must input floors that have conditioned space below them (floors between units). To do this correctly with the peculiarities in CALRES2, you must create a new construction assembly with R-100 or greater insulation to prevent modeling any energy transfer. This assembly can be of any thickness or material as long as it does not have a high heat capacity such as tile or cement. It may seem counterintuitive, but when modeling these floors over conditioned space, you must model the Exterior Condition as Unconditioned; CALRES2 does not offer Conditioned as an Exterior Condition choice at this time.

NOTE: You cannot model units in multi-family buildings in the four cardinal orientations and comply in all orientations as is done with subdivisions. You must model every orientation in which a multifamily building is constructed.

5.4.2 Whole Building

You may prefer to model the building as a whole. If you are planning more than one building and they are identical except in orientation, run separate calculations for each.

To help the building inspector later, when you name the opaque surfaces now for the different configurations, it would be helpful to use the same name for the same orientation wall across all the CALRES2 runs. For example, if you have three floors with four apartments each, and all the apartments share the front wall that faces north, you might use the name ExtNorth for that front exterior wall for the CALRES2 run for all twelve units.

Follow the instructions in Chapter 4 for single family dwellings. Enter all of the data for the actual building design. Be sure to set the number of dwelling units in under Building Info equal to the number of apartment units in each building.

NOTE: You cannot model a multi-family building in the four cardinal orientations and comply in all orientations as is done with subdivisions. Every orientation that a multifamily building is built in must be modeled.

5.5 Additions to Existing Buildings

Residential additions are a common type of new construction. An addition is defined as an increase in both the conditioned floor area AND volume.

You can use CALRES2 one of three ways when modeling building additions:

- *Addition Alone* - model the addition as a stand-alone design.

- *Addition plus Existing*, Whole House Method – model the proposed design for the addition *plus* the existing square footage of the house. **The entire building must meet mandatory requirements**.

- *Addition plus Existing*, Adjusted Energy Budget Method – model the addition and existing house, showing that the entire building complies with the current standard.

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5.5.1 Addition Alone Modeling

When you model the addition alone, you are essentially treating the addition as if it were a stand-alone building. Follow the instructions in Chapter 4 for modeling a single-family home. You will model all of the elements of the addition, but you will NOT model surfaces that are between the existing building and the addition (e.g., an exterior wall of the existing building that will be removed or altered with the construction of the building addition).

The internal gains for the addition are calculated based on the entry for fractional dwelling unit value ("Units") in the Building Information List as follows:

$$\text{Units} = CFA_{add}/(CFA_{existing} + CFA_{add})$$

Where: CFA_{add} = the square footage of the addition
$CFA_{existing}$ = the square footage of the existing house prior to the addition

For example, if you had a 1500-square foot existing house and were planning a 500-square foot addition, the fractional dwelling unit value ("Units") entry would be calculated as follows:

Units = 500 sq ft/(1500+500) sq ft = 0.25

Once this value has been calculated, enter it in the Building Information Schedule under Units.

If heating, cooling and water heating equipment from the existing building will be extended to the addition, model this equipment as if it were equivalent to the minimum package requirements (the package requirements can be found in Chapter 3 of the *Residential Manual*). If you will install new equipment to replace the equipment in the existing house, model the specifications of new equipment to be installed (note that the new equipment must meet mandatory requirements). Then run CALRES2 to determine if the addition complies.

> **NOTE**: If the total number of water heaters increases or a new water heating system that does not meet the standard water heating budget is added to the building as part of the permit for the addition, the Addition Alone method may not be used for compliance. In this case, see *Addition plus Existing, Whole House Method* or the *Addition plus Existing, Adjusted Energy Budget Method*, below.

> **NOTE**: When modeling an addition that is over conditioned space, you must model the floor by creating a new construction assembly with R-100 or greater insulation to prevent modeling any energy transfer.

5.5.2 Addition plus Existing, Whole House Method

The Whole House method is most useful when an addition that would not comply on its own is being installed on a fairly new house. The new house was built to recent (stricter) energy standards, and you can "average" the existing house and the addition together and perhaps get the whole new building to comply. You model the proposed new building (the addition plus the existing house) including any changes made to the existing building. The new building as a whole must have an energy budget less than the standard design. In addition, the existing portion of the house must meet all mandatory requirements under the current standard.

> **NOTE**: It is necessary to distinguish between *new* and *existing* opaque, perimeter edge, fenestration, and thermal mass surfaces on the C-2R compliance reports. To do this easily, you must input the words "New" or "Existing" in the Comment field for all of these surface types.

Follow the instructions in Chapter 4 for single-family homes. Entering the data into CALRES2 will be much easier if you have the building plans, blueprints, and/or take-offs for the addition and those for the existing house in front of you.

5.5.3 Addition plus Existing, Adjusted Energy Budget Method

This calculation technique is similar to the whole house method explained above in that energy efficiency improvements made to the existing building are factored into the compliance goal. Using the adjusted energy budget method requires two CALRES2 runs:

- the existing building alone (run #1)
- the entire building as it will exist after the addition (run #2)

You must assign the number 1 as the number of dwelling units for each run. The energy use of your proposed design must be equal to or less than the weight-averaged adjusted energy budget. You calculate the adjusted energy budget as follows:

Adjusted energy budget = $EB_{e+a} + (F)(EU_e - EB_e)$

Where:

EB_{e+a}	=	energy budget, existing plus addition, in kBtu/yr(sf)
F	=	$A_e/(A_{e+a})$
A_e	=	area of the existing building, in square feet
A_{e+a}	=	the area of the existing building plus the area of the addition, in square feet
Eu_e	=	energy use of the existing (unmodified) building, in kBtu/yr-sf
Eb_e	=	energy budget of the existing building, in kBtu/yr(sf)

The proposed design's energy use for the entire building (addition plus existing house) must be equal to or less than the adjusted energy budget. In formula form,

$EU_{e+a} = EB_{e+a} + (F)(EU_e - EB_e)$ must be true to comply.

Where:
EU_{e+a} = energy use, existing plus addition, in kBtu/yr(sf)

It is necessary to distinguish between *new* and *existing* opaque, perimeter edge, fenestration and thermal mass surfaces on the C-2R compliance reports. To do this easily, you must input the words "New" or "Existing" in the Comment field for all of these surface types.

For existing buildings, the values in Table 5-2 may be used as default assumptions.

	Default Assumption for Year Built			
Conservation measure	**Before 1978**	**1978 to 1983**	**1984 to1991**	**1992 to Present**
INSULATION (R-value)				
Roof	R-19	R-19	R-19	R-19
Wall	R-0	R-11	R-11	R-13
Raised Floor	R-0	R-0	R-0	R-19
Slab Edge	Actual	Actual	Actual	Actual
Ducts	R-2.1	R-2.1	R-2.1	R-4.2
FENESTRATION				
U-factor				
Single pane	1.19	1.19	1.19	1.19
Double pane	N/A	0.94	0.94	0.94
Shading coefficient	Actual	Actual	Actual	Actual
SPACE HEATING/COOLING EFFICIENCY				
Central Gas Furnace, AFUE[1]	0.75	0.78	0.78	0.78
Electric Resistance, HSPF[2]	3.41	3.41	3.41	3.41
Heat Pump, HSPF[2]	5.6	5.6	6.6	6.6
Air Conditioner (All), SEER[3]	8	8	8.9	9.7
WATER HEATING				
Energy Factor	0.53	0.53	0.53	0.53
Rated Input, kBtu/h[4]	28	28	28	28

1. AFUE = Annual Fuel Utilization Efficiency
2. HSPF = Heating System Performance Factor
3. SEER = Seasonal Energy Efficiency Ratio
4. kBtu/h = 1,000 Btu/hr

Table 5-2. Default Assumptions for Existing Buildings

5.6 Subdivisions and Master Plans

There are two options available to you when using CALRES2 for production housing. You may do the following:

- Model each building separately according to its actual orientation. Each building must comply on its own. Use CALRES2 as you would for any single building design calculation. Submit the CALRES2 CF-1R and C-2R generated for each building.

- Model a specific building design in the four cardinal orientations with identical energy-related features. If the building complies in each orientation, then the building and its "reverses" may be built in any orientation.

In this case, enter all of the data for the actual building design except enter 0 (North) for the "Front orientation" input in the Building Info List. Run the CALRES2 Calculations on this building. Then go back to the Building Info List and change the Front orientation to 90 (East). Repeat the calculation. Do this for the remaining cardinal orientations (180, South and 270, West). The proposed design's energy use for each orientation must be less than or equal to the standard design budget (the standard design budget will be identical for all four runs).

Follow the instructions for single-family homes in Chapter 4. Enter a comment in the Building Info schedule (accessed from the Lists menu) indicating which compliance option you used, and submit one CF-1R form and four C-2R forms to the building department.

> **NOTE**: There is an exception to the June 1, 2001, effective date of the 2001 Standards, and this exception applies only to subdivisions and master plans. Building energy efficiency standards compliance documentation submitted prior to June 1, 2001, using the Multiple Orientation Alternative of Section 151(c) of the Energy Efficiency Standards, will be used to determine compliance through December 31, 2001.

5.7 Using the Schedules Menu (from the Main Screen)

The **Schedules** menu (Figure 5-2) allows the user to take shortcuts compared to entering data through the Lists menu. **Schedules** is most useful when doing a large number of runs where a few parameters are being evaluated. With some practice, you can become familiar enough with using the schedules and worksheets under Lists to be able to move from there to the items under Schedules and make a change. It is key to remember that changes under **Schedules** will not always be transferred into the building data directly.

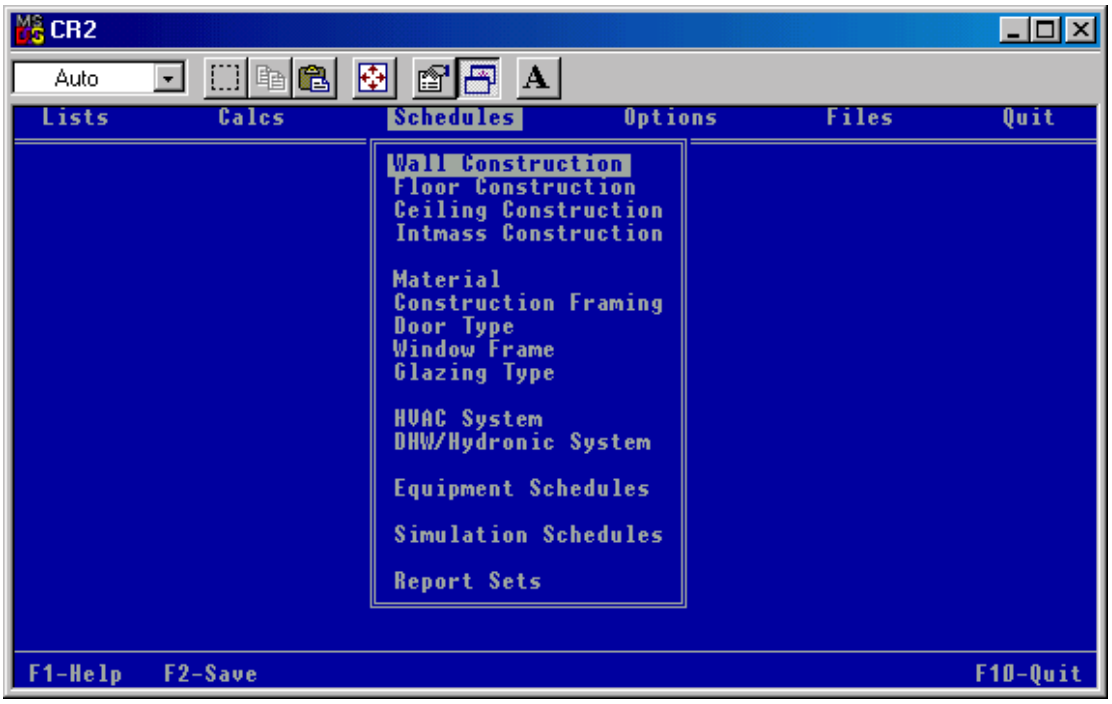


Figure 5-2. The Schedules Menu from the Main Screen

5.8 Using the Options Menu (from the Main Screen)

The Setup menu in Options (Figure 5-3) is used to specify special printer setup instructions. Printer setup strings can be entered here, such as escape sequences to set the pitch, margins and so forth. Refer to your printer manual for print setup strings. If no printer setup strings are specified, the output will be printed based on the current printer settings.

This menu also has input fields for your company name, address and telephone number. This is used to specify the name of the company preparing the compliance documents so that every time CALRES2 prints compliance forms, this information is included.

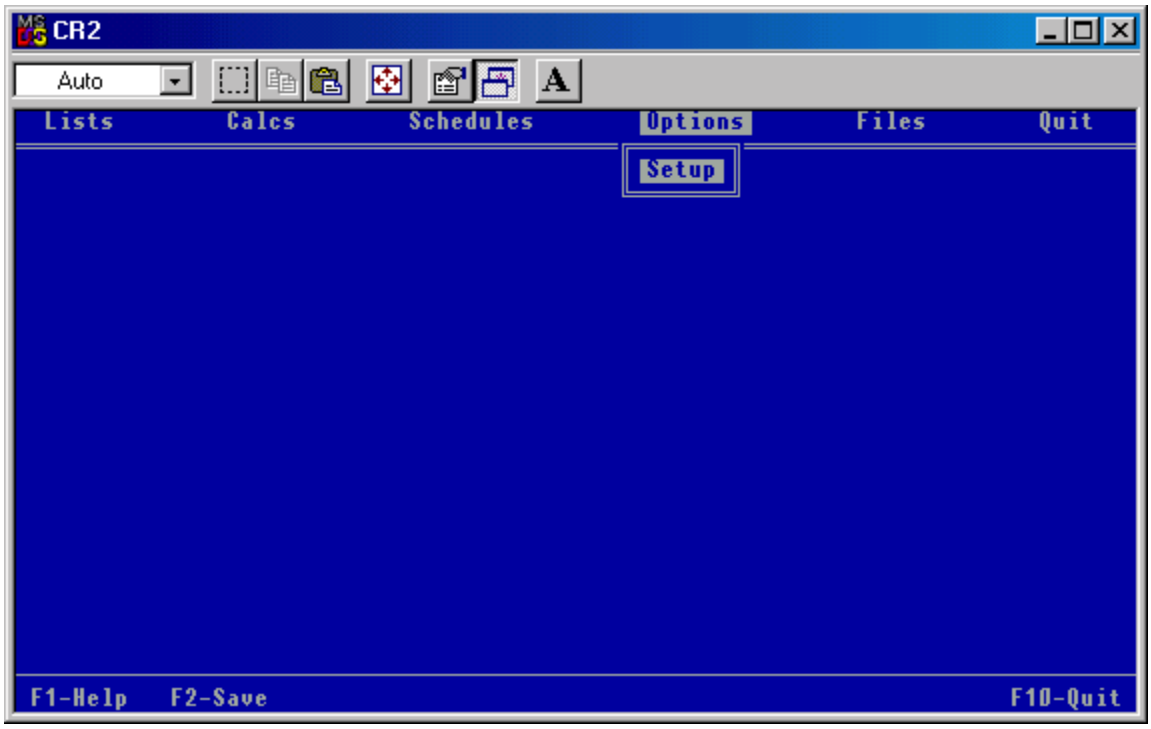
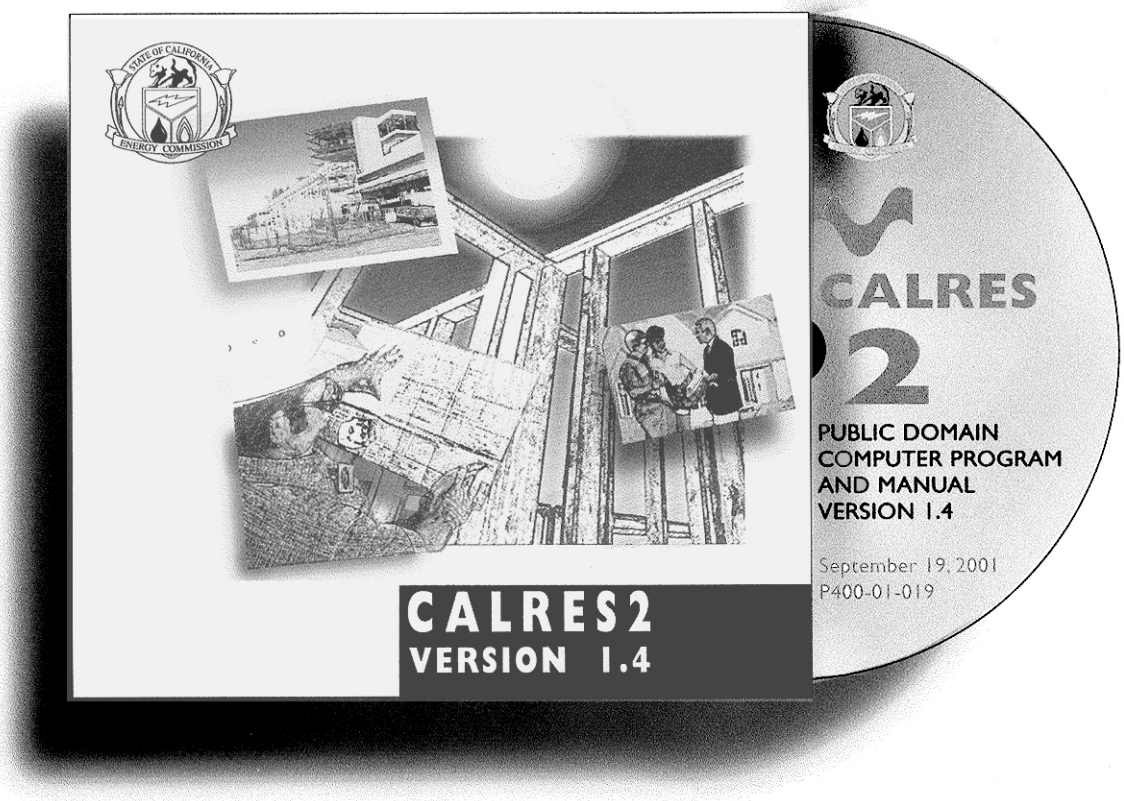


Figure 5-3. The Options Menu from the Main Screen

CALRES2

USER'S MANUAL

VERSION 1.4



PUBLIC DOMAIN COMPUTER PROGRAM FOR

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COMMISSION ADOPTED STANDARDS

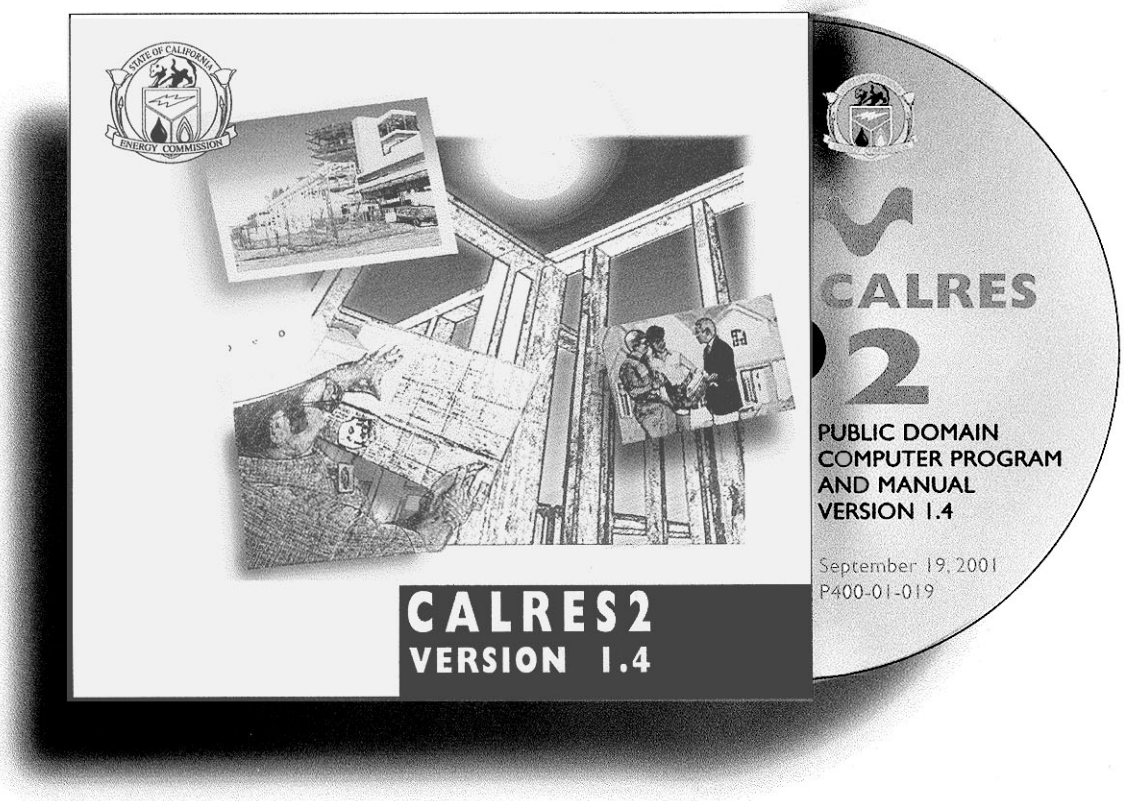
September 2001
P400-01-019

Gray Davis, Governor

CALRES2

USER'S MANUAL

VERSION 1.4



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